The American Journal of Surgery

VOLUME 98 OCTOBER 1959 NUMBER FOUR

Symposium on the Medical Aspects of Traffic Safety and Related Injuries

Introduction

MOTOR vehicles have been a tremendous force in the economic and cultural growth of America. But, like the atom bomb, the automobile must be controlled if its full potential for good is to be realized. Improperly driven, it has become the most dangerous weapon ever placed in the hands of a civilian population. The current totals of about 38,000 deaths and over 1,400,000 disabling injuries yearly makes this clear. Since the turn of the last century there have been more than 1,250,000 deaths due to automobile accidents. Compare these figures with 605,000 battle deaths incurred in all the wars in which the United States has participated. The automobile in fifty-eight years has killed more than twice as many Americans as have bullets and shells in the last two centuries.

Safe driving under most circumstances is the result of making the right decisions at the right time under actual automotive, traffic, road and weather conditions, and applying the right driving skill in support of each. Many driving decisions are not left to the individual judgement of each driver. Instead he must conform to standard practices, spelled out as law. Obedience to those standards is expected by society under all conditions.

As safe driving is the result of making proper decisions in all circumstances, the physical and mental condition of the driver are of the utmost importance in making those decisions. Therein lies the responsibility of the physician. While his primary responsibility is the care of the sick and injured, few would deny that the most brilliant achievements of modern medicine are in the field of preventive medicine. The medical aspects of traffic safety are in this category.

Organizations devoted to traffic safety, local, state and national, are doing an excellent job. It has been shown repeatedly that, due to the intensified activities of these groups, there has been a reduction in the number of traffic deaths and injuries. The death rate per mile has been cut in half in the last seventeen years. Yet the leading cause of death in the United States of persons one to thirty-six years of age is accidents. Motor vehicle accidents account for more than 40 per cent of all accidental deaths.

Physicians have not yet realized the importance of their role in this important No. 1 public health problem. They must lead the way in research to determine the relationship of physical and emotional states to motor vehicle accidents. They ought to be critical in certifying persons for driving, and they should attempt in every way to convince their patients who are not qualified to drive, to give up this privilege.

Industry and industrial physicians have been interested in the prevention of motor vehicle accidents for many years. The industrial physician has the responsibility for evaluating the physical qualifications of commercial drivers. He must make periodic examinations, and he has the opportunity to observe the commercial driver over a period of years and to compare his physical and emotional status to his accident record.

Motor vehicle drivers may be classified into two general groups, private drivers, and commercial or industrial drivers who drive for a

living. The latter group is subjected to more rigid regulations than the former, and is generally more proficient and law abiding.

For many years the automobile companies have been aware of safety factors in automotive construction and design. The present automobile is an engineering masterpiece. When it stands motionless at the curb, it is an object of beauty and craftsmanship, but with a driver at the wheel it can become as dangerous as a bomb.

The automobile crash injury research program at Cornell University has done an excellent job. Statistical facts compiled have added greatly to our general knowledge. For the most part, this program has been directed toward motor vehicle design and associated safety features. There is no doubt that this program has been a stimulus to automobile manufacturers and has affected automobile construction.

Due credit must be given to police departments, courts and other law enforcement agencies for their continued diligence and recognition of responsibility. They are employed by citizens to enforce obedience to laws. They impose penalties for traffic violations and dissuade the individual from further violations, all for the sole purpose of improving adherence to traffic safety regulations and laws.

There may come a time when the issuance of a drivers license will include a more detailed appraisal of the physical defects of the applicant. It is my personal belief that this time is not too far off. The investment of surplus time, in safe driving, pays rich dividends.

The physician is the best person to appraise the physical, mental, emotional and physiological impairments of an automobile driver. While we as citizens must be concerned with all phases of human safety, the medical aspects of traffic safety are fundamentally the responsibility of the medical profession.

In discussing medical aspects of traffic safety, it seems logical to discuss the related injuries that occur, together with their primary or immediate management. If we are to elaborate upon medical aspects of traffic safety, we should know what happens when there is no traffic safety. The general title, "Symposium on the Medical Aspects of Traffic Safety and Related Injuries," will include this approach. The contributors have been selected because of their special interest and knowledge. All facets will be covered, from the time that a person first has the opportunity to drive a motor vehicle, and will be directed toward the final recommendations that may help to insure him against self-extermination.

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An Ounce of Prevention, A Pound of Cure

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THE development of modern highway travel has greatly increased the proportion of severe injuries in surgical practice. It has also extended their areas of occurrence from a few limited fields to almost every square mile of the country. Injuries have always been important to individual victims, but never before has their frequency of occurrence created such a national problem. Today, the automobile is by far the greatest single instrument of disability and death in our society, not excluding even war.

Society has long recognized inescapable hazards faced by large groups, and has adopted measures to minimize them such as departments of health, police and fire departments and regulation of common carriers of human beings. It has also enacted laws regulating highway traffic in an effort to protect travelers, but few laws are so disregarded as these. Furthermore, it is impossible in a free society to place such restrictions upon the individual citizen as are placed upon those responsible for the safety of many. Vocational skill, physical condition and temperate habits are basic requirements for a license to pilot a commercial airplane or to operate a locomotive. Even taxi and truck drivers, in most states, must pass a more rigid test than the operator of a private automobile.

However, since the motor car has become a substitute for the human foot, requirements for permission to operate one are scarcely more demanding than those placed upon a pedestrian. Thus we are faced with the situation that our highways are crowded with effective engines of destruction controlled far too often by persons incapable of limiting their potential to harmless ends. It seems to be a quirk of human nature to assume both that accidents are misfortunes which occur only to other people, and that they are invariably the result of the negligence or the poor judgment of the victim. With this philosophy, the average man believes that he is fully able to protect himself.

Unfortunately, in traffic accidents especially, the innocent suffer with the guilty, and too often suffer more. Regardless of his skill and his respect for law and regulation, every man places his health and his life in jeopardy when he closes the starter switch of his automobile. This risk is increased in inverse proportion to the level of the care and treatment of trauma in the locality in which he finds himself.

While prevention of traffic accidents will always be the most effective and most economical method of reducing this toll, for the reasons given it will fall far short of a complete solution. The carelessness, the indifference, the resistance to restriction of individual freedom, and even the ingenuity of man in setting the stage for his own destruction, will frustrate the most perfect plan for his protection. The safety of industrial machinery has been immensely improved over the years, and accidents in its use greatly reduced. Today's automobiles are also safer, but safety devices in the driver are something which cannot be built by the automotive industry. Even such safety devices as seat belts are of no value unless they are used. In anticipating the promised electronic control of cars on main highways, it must be remembered that speed control governors were of little value because they could be easily disconnected. Thus there must always be effective means for the salvage of the wreckage man creates.

More often than not, the ultimate outcome of a severe injury depends to a greater degree upon the skill immediately at hand than upon later care and treatment. Professional skill can rarely be made available at the scene of a highway accident, and victims must first be cared for by laymen. While the American Red Cross has for years conducted excellent courses in first aid, far too few public servants charged with rendering first aid, such as police and

ambulance attendants, have availed themselves of such training. Untrained Samaritans are often more dangerous than the accident. The first requirement for salvage, therefore, is adequate training of everyone whose duties involve emergency care and transportation of the injured.

The great increase in the number of community hospitals in the past few years has brought professional skills and equipment closer to the accident victim. If bricks and mortar, and x-ray equipment and laboratories could heal the broken, we would have gone far toward reducing the chances of death or permanent disability as sequels of traffic accidents. Unfortunately, these inanimate objects are no more effective in repairing the results of an accident than is the motor car in preventing them. The effectiveness of both hospital facilities and automobiles depends upon the quality of human direction.

The care and treatment of trauma is within the field of the surgeon. Trauma creates problems rarely encountered in other surgery, and special training and experience are necessary to deal with them properly. It required a World War to disclose a serious weakness in the training of surgeons in the United States. In no previous war had there been so many well trained surgeons to serve the Armed Forces—well trained for every requirement of surgery save that most necessary in war, the surgery of trauma.

Many, if not most, of the young board diplomates who served in World War II had been trained in hospitals to which victims of accidents were rarely brought. They were highly competent in every elective procedure and in emergencies arising within the body, but they were too often inadequate when confronted with open fractures associated with large areas of devitalized tissue, sucking wounds of the chest, and those concomitant conditions of all serious injury, hemorrhage and shock. They had yet to learn that patients with severe injuries to the head could be transported safely before surgery, but not afterward for some time. Above all, they had to learn that the best treatment often consisted of not doing rather than doing.

The great changes of the past few years in the economics of medical care have affected the relationship of many voluntary hospitals to the community. Non-revenue producing facilities are luxuries which many hospitals feel that they are no longer able to afford. Victims of accidents are usually unable to make a deposit in advance, and emergency rooms are operated at a loss. This has resulted in the segregation of patients with trauma into public hospitals and the few voluntary hospitals which can afford this contribution to the community.

It is generally agreed by surgeons that the poorest surgery in this country is, in general, the surgery of trauma. It is paradoxical that young surgeons are better trained for elective surgery than for the surgery of severe injury, since there should be more opportunity for training and experience in the treatment of the injured.

In the first place, injury occurs more frequently than any other one surgical condition. In the second place, more responsibility can be placed upon the surgical resident in such cases. He is available when the patient arrives, and his participation in treatment is rarely limited by the patient's choice of the surgeon as it is in elective procedures.

The quality of instruction being taken for granted, all that is lacking in the training of the young surgeon in trauma is the availability of material, and this is something which is controlled largely by the hospital in which he is being trained. This deficiency in resident training of the surgeon can be remedied in one of two ways: the encouragement of treatment of trauma by the hospital, or affiliation with another hospital with a large trauma service through which surgical residents may be rotated.

Some of the handicaps of resident training would be overcome by such a program. The opportunity for independent surgery, upon which great value is placed by the accrediting agencies, would be greatly enlarged; and many of the general principles of surgery are applicable in trauma as well as a few special principles.

American surgery has much of which to boast, but until the general level of the quality of surgery of trauma is elevated, an exception must be made. As the population grows, as the number of cars on our highways increases, trauma will play an increasingly important part in the work of the surgeon. It is not enough to lower the mortality of elective surgery to the vanishing point or to expand the usefulness of surgery into new fields while doing too little for the broken and the maimed.

The Medical and Civic Responsibilities of the Physician in the Prevention of Automobile Injuries and Deaths

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IT is the physician's duty to inform the public and its legislative representatives of the seriousness of automotive injuries, for they are not as yet interested enough to do anything (probably because of the very human trait of believing that such things only happen to the other fellow and because of their indifference to statistical figures and slogans).

To correct this basic cause of the rising trend of deaths and injuries associated with the increasing number of vehicles on our highways we must depend on education. However, it is doubtful that any real improvement can be accomplished soon. This generation is lost to driver education but if we plan for the future by seeing that all public, private and parochial schools provide an approved and adequate driver training course with behind the wheel instruction we will have taken a great step forward in the solution of this number one public health problem. Similar courses should also be provided for the public, for the instruction of beginners and for those whose licenses have been suspended or revoked and who wish to re-apply for licensure when such a certificate has been required by the courts.

If the seriousness of this problem as it exists today were realized by the public it could perhaps be aroused from its complacent attitude enough to demand that legislators do something now to salvage many thousands of this present generation from death and the crippling injuries which will otherwise occur. Fortunately the medical profession even now, as a result of its still incomplete and meager research studies, can point the way to remedies which could cut this tragic toll by perhaps 50 per cent or more, if employed.

Among the statistical facts which the public should know are the following: There is one crash every three seconds with one death and twenty-five injuries every ten minutes; 20 per cent of these injuries are classified as from severe to critical; patients with such injuries constitute 8 per cent of all hospital admissions and the repair of these injuries is one of the most frequent surgical procedures performed today; in all our wars less than 1 million men have been killed, while the automobile counted its 1 millionth victim more than five years ago; the leading cause of death in this country today is cardiovascular disease; the second is cancer but close behind are deaths due to automobile accidents if figured on the man years of life lost, for the first two are primarily diseases of the older age groups whereas the death rate from automobile accidents is highest in youth.

If doctors had waited until all the facts were known before starting on the control of such scourages as smallpox, typhoid, diptheria, malaria, syphilis and poliomyelitis, for example, their control would have been long delayed. We realize the importance and need for basic research in the ultimate solution of this problem but until such facts are at hand we can use the remedies we now have in a practical, clinical way; we can immediately begin the control of this number one problem and at the same time point out, carry on and encourage basic research in all the many phases of this problem in order to hasten its final solution.

As a result of our studies we know that the greatest number of deaths are caused by the

driver who has been drinking. He accounts for 50 per cent or more of these deaths. The next in frequency is the speeding and reckless driver who accounts for approximately 30 per cent or more. The remainder are caused by many things such as mechanical failure, physiological states such as sleep and fatigue, pathological conditions as epilepsy, diabetes treated with insulin, cardiovascular disease and drugs and emotional disturbances at times and, also, many other conditions too numerous to mention at this point.

As a result of the Cornell crash injury studies and other similar studies we know that in order of occurrence the most frequent sources of death or injury are from: the steering assembly; ejection; dashboard and windshield; and the back of the front seat, etc. The most frequent body areas affected are: (1) the head and neck, (2) the chest, and (3) the extremities, etc.

To partially solve this problem we as physicians and citizens would like to make the following suggestions:

Education. Driver training courses should be provided for all our teen-age youngsters as well as for adults. This course should be a required one, and if time is a factor in a crowded curriculum such courses as physical education, home economics, art, music and shop instruction should yield time to driver training. A certificate from such a course should permit a youngster to apply for a driving permit at the age of sixteen instead of eighteen, which otherwise should be the legal minimum limit. Such a certificate could also result in lower insurance premiums. These courses are invaluable in teaching safety from all approaches such as the danger of driving while drinking, the danger from speed and recklessness, and the value of safety features in design as well as safety belts and shoulder harnesses.

Alcohol and Driving Safety. Since the average individual suffers impairment of driving skill at a blood alcohol level of .05 per cent let us make this the critical level for conviction instead of 0.15 per cent, a far too generous figure.

A chemical test of the breath or blood should be mandatory in all cases in which driving while drinking, but not intoxicated, is suspected. This test would free the innocent as well as help convict the guilty and should be administered by a properly qualified testing officer who has been trained both in the care of his equipment and the technic of its use or by a physician. The alternative to such a law is the implied consent law as has been provided in New York and other states.

The result of the chemical test should be accepted as *prima facie* evidence, and mandatory laws for the various zones of intoxication should be provided.

The present laws exonerating a driver of drinking and driving with a blood alcohol level of less than .05 per cent are proper. The present laws punishing those with a blood alcohol level of 0.15 per cent or higher are often proper but are not enforced. These laws should be subject to study and revision, and should also be strict and mandatory. The greatest problem is in the twilight zone of from .06 to 0.15 per cent. For this zone a new set of laws should be enacted following the suggestions of Mr. William M. Plymat of the Preferred Risk Mutual Co. of Des Moines, Iowa. These laws should be less strict than those for people with a blood alcohol level of 0.15 or higher but should be severe enough to control the average drinker, for this is the range of the social drinker. These laws, as I have previously said, should be mandatory and strict enough to stop a driver who is not drunk and thinks he is perfectly capable of handling a car in our modern high speed traffic. The results consistently prove him wrong. Many states have found a point or demerit system to be the best solution to the problems of suspension or revocation of license for drinking and driving. However, if testing of the breath or blood could be made mandatory, its results accepted as evidence and mandatory laws provided, this would be the simplest method of handling this whole problem.

In answer to the many arguments pro and con in this complex problem, the physician is not interested in whether the degree of intoxication is reached on an ascending or descending curve of intoxication. He is not concerned with the type or rapidity of consumption of the alcoholic beverage or whether it is consumed on a full or a fasting stomach. He is not concerned with whether the individual is a beginner or an experienced drinker. He is only concerned with the fact that no one should operate an automobile in our modern high speed and complex traffic patterns with an alcohol blood level higher than .05 per cent.

The laws concerning the punishment of these offenses should not be left to the discretion of the judge or consulting physician for they have both failed miserably in the past. As a citizen a physician should urge that full time traffic court judges be appointed with a salary commensurate with the importance of their function. Also, proper and dignified quarters should be provided for this most important court.

Speed and Reckless Driving. Since speed and reckless driving are causative of some 30 per cent or more of deaths resulting from crashes, I suggest that more State police be utilized, that the public be educated again to support them and to cease playing "cops and robbers" on the highways, and that proper laws be enacted and made mandatory. We should endorse and enforce the uniform adoption of the speed limits suggested by the National Safety Council. These limits are 60 miles per hour for day, 55 miles per hour at night and 35 miles per hour in urban zones, all with a 5 miles per hour tolerance. Dual lane and other modern highways should likewise have a minimum limit of 40 miles per hour.

These limits may seem somewhat low to many readers, but until the manufacturers provide us with safer machines from the standpoint of human engineering, I believe that these limits should be considered the maximum under present conditions. If and when the day comes that the manufacturers provide cars employing the many safety suggestions previously offered by the medical profession, then these limits can be raised accordingly. Again, the laws governing speed and reckless driving should also be mandatory and strict enough to deter these individuals from excessive speed and recklessness, for the public must realize that driving a motor vehicle today is a privilege and not a right. Nor should sympathy be wasted on the so-called "hardship case," for you may be his next victim. He knows the wages of each offense, whether set by mandatory law or as a result of the point or demerit system and no deviation can be allowed if the number of deaths and injuries is to be curtailed.

Automotive Design and Safety. Since some crashes are unavoidable and others inevitable, it is important that the machine itself be designed and safety features provided to protect the occupants. At the present time the destiny of thousands rests in the hands of a comparative handful of men, the designers and engineers who plan next years cars without benefit of medical advice or consultation. It is also astounding as to how little money is spent on research for safety features compared to the large sums received from the sale of their products.

The Committee on Trauma of the American College of Surgeons has been concerned with the importance of safety design of the vehicle and the provision of safety features as standard rather than optional equipment. Their efforts have the whole hearted support of all physicians, particularly the American Medical Association's Committee on Medical Aspects of Automobile Injuries and Deaths. Although this Committee is primarily interested in the medical aspects of the problem their studies and the reports of research groups, such as the Cornell study group, has convinced them that design should occupy a high place on the list of objectives.

This decision is based upon the fact that 12 miles per hour seems to be the critical speed, for at this point the average steering wheel collapses, leaving the steering post as a lethal projection; no one can protect himself from death or injury, and if thrown out of the car the chances of getting killed or hurt are five times greater than if one had remained inside the protective shell of the vehicle. The seat belt, or, preferably, the shoulder harness is the best safety feature that can be provided at this time and, if worn, will prevent some 60 per cent or more of deaths and injuries. The belt should be anchored to the floor of the car, and must meet the safety specifications of the Society of Automotive Engineers. If belts are not provided as standard equipment, provision should at least be made for their attachment.

Many suggestions have been made which would contribute to passenger safety at little extra cost for the manufacturer. Among these suggestions are: a collapsible steering assembly; Ford's deep dish steering wheel with a broad steering post covered with protective crash padding; the same type of padding over the dashboard, the back of the front seat and other dangerous areas in the car; seating the passenger in the front seat farther away from the dashboard; firm anchorage of seats; visual or audible speed signals; and additional small red lights on the top of the car to flash when speeds of 70 miles per hour have been obtained. The latter would serve as a warning to the police as

well as to other motorists that a car is driving at excessive speeds. In addition to these signals the following devices are recommended: safety door locks; polarized headlight lenses and an oppositely polarized spot on the windshield to prevent headlight glare and blinding at night; better designed windshields from an optical standpoint; high extensions of the seat backs to prevent whiplash injury to the neck; a recessed shelf behind the back seat to prevent injury from secondary missiles; less chrome and other reflecting surfaces to eliminate glare especially in night driving; elimination of projecting knobs, buttons and levers; shock absorbers for bumpers or energy absorbing material in the front end and many other features.

If the front seats are firmly anchored to the floor and if the backs of these seats will not tip forward then small accessory seats for children can be made to hook over the top of the seat and secondary belt extensions will go around the waist of the very small youngsters. Older children should be made to ride standing back of the front seat or, if riding in the front seat, in cases of impending crash, they should be instructed to dive to the floor with their backs to the front floor area or back of the front seat, wherever they may be.

Most of this extra cost could be compensated for by less chrome, the omission of hood ornaments, clocks and radios and many other accessories as standard equipment. As I have previously said, one is astounded as to how little has been spent on safety research by the manufacturers compared to the vast sums which they receive from the sale of their products.

I am sure that consultation with the medical profession on the aspects of human engineering as related to automotive engineering would soon establish many related facts; these would bear fruit by reducing deaths and injuries at the time of a crash and converting many of the potentially severe to critical injuries to those of relatively minor nature.

Licensing of the Driver. The suggestion has been made that three classes of driver permits be granted: one for private vehicles, another for commercial vehicles and a third for passenger-carrying vehicles. Each person could thus acquire one or more such permits depending upon his vocation and desire. If suspension or revocation of a permit is ordered by the court it could apply to all three categories or to one or more depending on the offense or series of offenses. For instance, a truck driver could continue to drive his truck but would be barred from driving his private car.

As physicians we also believe that on each driving permit a space should be provided to state the blood type of the individual, his allergies to various drugs if any, and whether he is taking anticonvulsive or anticoagulant drugs or is a diabetic taking insulin. This information would be of tremendous value in the care of unconscious patients brought into the emergency rooms of hospitals.

Re-examination should be required every three years for drivers of private vehicles but every year for those who wish permits in the other two classes. This would also apply to drivers of school buses and those past age sixty-five. The automatic reissue of driving permits every few years should cease, for under this system the only requirement for reissue of a permit is to be alive.

It has also been suggested that referral medical clinics be established by cities, towns or counties to be staffed by doctors appointed by local medical socities, with consultants available in psychology and the medical specialties. It would be the duty of this referral medical group to pass on the physical and mental fitness of those people referred to it by the courts, the police or other physicians. Their opinion would be particularly valuable in the consideration of the licensure of repeated offenders.

State medical societies are appointing Traffic Safety Committees to serve as consultants to State legislatures and licensing authorities on the medical aspects of this problem.

The American Medical Association has recognized its responsibility in this field and through its Committee on Medical Aspects of Automotive Crash Injuries and Deaths has prepared two pamphlets. One entitled, "Are You Fit to Drive?," is written in lay language and illustrated for the instruction of patients whose condition may pose such a query. This little pamphlet is attractively illustrated with color and line drawings. It briefly discusses many problems in subjects such as: Before You Take the Wheel, Emotional Upsets, Drowsiness, The Taking of Medicines, The Drinking of Cocktails, The Importance of Vision and other interesting features. This booklet may be obtained from the Association of Casualty and Surety Companies, 60 John Street, New York 38, New York, and is particularly suitable for

distribution to the patients in the doctor's office. If wide distribution of this pamphlet can be secured we believe it will be of considerable help in the solution of this problem. A second pamphlet is entitled "A Medical Guide for the Physician to Determine a Patient's Fitness to Drive."* This pamphlet covers the medical aspects of the problem for the first time and serves as a reference to the physician when confronted by the patient who has a problem concerning a physiological state, a pathological condition, an emotional disturbance, drug therapy or alcohol.

The Committee is at present beginning the preparation of a "Guide to State Licensing Authorities." This will be more comprehensive and detailed, and will set certain physical standards for certain conditions. It is hoped that the state medical societies will make the conditions of patients with convulsive seizures, mental or severe emotional disease and those diabetics taking insulin, reportable to the State Health Department. These names would then be furnished by the State Health Department to the motor vehicle licensing authority of each state and would serve as a guide and double check to them in the licensing of these individuals. The publication of this "Guide" is somewhat in the future, but the need is great and its preparation will be carried out as rapidly as possible.

Of course, the physician's first duty is to render adequate definitive treatment to the injured and of these results he is justifiably proud. He is likewise interested in seeing that first aid care and emergency transportation are adequate and available and that properly trained and equipped rescue squads are established in each community. These squads should be a part of the Civil Defense program.

SUMMARY AND CONCLUSIONS

In spite of the physician's accomplishments in the care of the wounded, his main interest, as in all other major medical problems, is in the prevention of disease. To attain this goal I would like to present the following summary of the aforementioned recommendations.

1. New laws to curb drivers who have been drinking.
2. Proper and uniform speed laws.
3. Minimum safety features in design and equipment as standard, not optional, features.
4. Referral medical clinics.
5. Three classes of driving permits for private, commercial and passenger carrying vehicles.
6. Driver education courses in all public, private and parochial schools.
7. The consideration of a point or demerit system.
8. More state police.
9. Further engineering studies of highways and all related factors as well as of the machine itself.
10. More time and money spent on basic research.

However, for the present, let us employ the information we now have, for by so doing deaths and injuries could be curtailed substantially, perhaps by 50 per cent or more.

In conclusion I would like to quote a statement from Col. C. W. Woodson, Jr., Superintendent of the Virginia State Police, which is as follows: "With modern traffic what it is pleasure driving has ceased to be. Survival on the highway today calls for a mechanically perfect vehicle and a driver who is mentally alert, in good physical condition and aware of the dangerous task he is performing." I would like to add that the car should have proved and built-in safety features in case a crash should occur.

The physician is proud of his definitive care of the injured but does not believe that his duty as a citizen and a physician has been fully discharged until preventive measures have become facts and are reflected in the daily automotive statistics.

* *J. A. M. A.*, 169: 1195–1207, 1959.

The Responsibility of the Medical Profession to the Victim of the Automobile Accident

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IN this era of speed promoted by excellent highways and high-powered motor cars, the "automobile-crash injury" with its resulting disabilities and fatalities has assumed enormous importance as a public health problem. Therefore, the medical profession has a tremendous responsibility to participate in all efforts to attack it. As in any public health problem, there are two phases to be considered. The first is the prevention of injuries and the second is the treatment of the victim. The epidemiological approach to a disease is often entirely the responsibility of the medical profession. A concerted effort often succeeds in isolating the single cause of a disease, in which case the problem can be solved by eliminating the causative agent or by its spread. Through this classic approach, such plagues as smallpox, diphtheria and typhoid fever have been almost completely wiped out in this country. The problem of automobile-crash injuries is, however, much more complex. There are many contributory causes, and the medical profession has neither the primary responsibility nor the ability to control these except in an advisory capacity.

PREVENTION OF ACCIDENTS AND INJURIES

The first and perhaps the most important factor both in the cause and the prevention of automobile-crash injuries is the performance of the individual driver. This problem has many aspects, and there are some in which the medical profession can be helpful. Although primarily the responsibility of law-enforcement and other governmental agencies, the improvement of driver education and of examinations for license to operate a motor vehicle can be greatly facilitated by the medical profession. Physicians can lend their strong support to the movement to provide programs of driver education and to encourage more people, particularly teen-agers, to take advantage of those now being offered. They can also advise the governmental agencies concerned as to proper procedures for examination in the licensing of operators, especially in such matters as visual and psychological testing.

The second important factor, that of law enforcement, is entirely the responsibility of the governmental agencies, and the medical profession can do little more than act in an advisory capacity.

The third important factor in the prevention of accidents concerns highway engineering. Certainly this is a problem primarily for the engineers. However, the medical profession can help with information about the reactions of drivers to certain highway situations, such as the hypnotic states which may be induced by long, straight, monotonous stretches of road. There are other reactions of the driver to his environment that can be explained medically.

The fourth important factor concerns the prevention of injury in inevitable accidents and involves automotive design and engineering. The primary responsibility lies with the automobile manufacturer and designer, and the medical profession can only advise as to certain medical aspects of the problem. The Cornell Automotive Crash Injury Research project has made a distinct contribution by indicating the injuries inflicted by certain dangerous areas in the automobile [1]. The results of studies by the Cornell group have materially aided the automobile manufacturer in improving the interior design of the car and in preventing certain situations in which it is known that the passenger may be injured. The report of the Automotive Crash Injury project was first considered by the American College of

Surgeons in 1954 and was transmitted to the major manufacturers with a request from the Board of Regents that certain improvements be made in the interior design of the automobile. As a result, one manufacturer incorporated all five of the suggestions made by the American College of Surgeons in the 1956 models. These were: (1) improvement of door locks to prevent the ejection of the passenger; (2) seat belts to prevent ejection and to prevent the injuries resulting from the passenger being thrown against the front of the car; (3) proper padding of the dashboard; (4) improved design of the steering wheel to prevent impaling of the chest by the steering column; (5) fixation of the front seat to the chassis to prevent propulsion of the seat and passenger towards the front of the car. Other automobile manufacturers incorporated some of these improvements in their products.

Recent reports from Cornell Automotive Crash Injury Research project [2] have shown that the use of improved door locks and of seat belts has resulted in a very dramatic and statistically significant drop in the incidence of injury and mortality in automobile accidents.

It is to the credit of all the automobile manufacturers that many safety innovations, such as safety glass, better brakes and improved tires, were instituted long before they were suggested by the medical profession. Although it is quite true that fatalities and injuries have increased in past years, so also have the number of cars on the road and the number of miles driven by the automobiles in use in this country. It would seem that the rate of injury and fatalities has not increased as rapidly as the increase in the number of automobile miles driven. This would indicate that the automobile manufacturer has been successful in his efforts to provide a safer car. There have been a number of unreasonable accusations against the automobile manufacturers, particularly since the problem of safety has been considered more widely. These accusations have implied that injuries and fatalities in automobile accidents are due primarily to faulty automotive design. In some quarters it has been suggested that if the automobile were properly made, the number of fatalities and injuries would be reduced to a ridiculous minimum. This, of course, is an unfair accusation, and it is the duty of the medical profession to pay more attention to the care of the patient and to leave to the automobile manufacturer, designer and engineer the manufacture of the automobile.

TREATMENT

The second phase in this public health problem involves the care of the injured patient and his restoration to health. If the automobile manufacturer is at all to blame for the design of his automobile, the medical profession must also share some of the burden of guilt, since the care of the injured victim of an automobile accident in most parts of this country certainly leaves much to be desired. If the medical profession were to pay more attention to the care of the injured patient than to the design of the automobile, more injured patients would be treated with fewer fatalities and with fewer crippling disabilities. Let us, therefore, pay attention to our own specialty in which we are expert, and leave the other problems to those who are more expert in their fields.

Education. One of the reasons that the care of the injured person is good in some areas and indifferent in others is the fact that most accidents are emergencies, and the final outcome of the case may rest entirely on what is done to the victim immediately after he has been injured. In such fields as cardiac, thoracic and neurological surgery, patients may be transported long distances to special centers where highly specialized experts can examine and treat them in a leisurely and thorough manner. However, in the field of trauma the important surgeon is often the nearest doctor, and he does not always have the knowledge or the time to carry out expert care. It is, therefore, necessary that the medical profession stress education in this field so that the injured person may be more assured of proper care.

Our medical schools are usually more interested in teaching other aspects of diseases, and are often negligent in training students in trauma, a subject that is pushed off the curriculum in favor of what seem to be the more interesting fields of medicine. With an ever-growing percentage of our population being injured in automobile accidents, it would seem that our medical schools would do well to increase the number of hours devoted to the teaching of the surgery of trauma.

Postgraduate education of interns and resi-

dents is deficient in many institutions in this country, and particularly on those surgical services which emphasize general surgery and a few surgical specialties. Trauma sometimes does not even occupy a part in the training. It is a sad commentary on our postgraduate education when a young man taking examinations for a hospital residency admits that he knows nothing about fractures or trauma and has never had any training in these subjects.

The medical societies and associations also have a responsibility in this field, and it will be through their efforts in broadening the education of all physicians that the first-aid principles of splinting, transportation of the injured, and proper care of the most seriously injured patient will be made applicable by any doctor, regardless of his specialty.

Responsibility of the Hospitals. It is the responsibility of every hospital to prepare for the reception and care of injured patients, and this means that a staff should be available at all times. This staff should be well trained and equipped to handle the expected number of victims of accidents brought to the Emergency Room. The philosophy of the responsibility for victims of accidents is not as well understood in many hospitals as is the responsibility for patients with such things as perforated ulcers, ruptured ectopic pregnancies, and other acute abdominal emergency conditions. An attitude is often assumed that the victim brought his trouble upon himself and the hospital, therefore, is not responsible. If the patient can be taken care of with what is usually available, the hospital believes it has discharged its responsibility.

Hospitals should have a very definite plan of assignment of senior surgeons who are available to examine and direct the treatment of seriously injured patients. Often the least experienced member of the staff, intern, substitute intern or student, is the first one to see the victim of an accident and often is the one who is responsible for the early care. Furthermore, a hospital should have the proper equipment available for these patients. This means a laboratory for such determinations as blood grouping and matching, adequate x-ray facilities, provisions for proper splinting, essential drugs, sufficient blood for transfusion, and a well equipped operating room.

The responsibility of the hospital for transportation from the site of the accident to the Emergency Room is sometimes shared with other agencies, such as the fire and police departments and private ambulance carriers. Perhaps this is not a problem of the individual hospital but it is certainly the problem of the medical profession, and it is very poorly handled at this time throughout the country. Some concentrated effort should be made to insure that expert handling of the victim is available and that the primary first-aid care is provided well before the patient reaches the hospital.

The public and many hospital authorities have the idea that speed is the most important element in the transportation of an injured patient. This is, of course, erroneous and the need for care and gentleness should be emphasized, as Curry and Lyttle have shown [3]. Speed is rarely necessary and is often dangerous to the patient, attendant, ambulance driver and everyone else in the path of the ambulance. Ambulances should be made to travel at normal speeds and should rarely, if ever, be allowed to break traffic laws. The thrill of the speed and the pleasure of special privilege are really the reasons for the speeding of ambulances, and this can only be controlled by proper traffic laws and ordinances.

Responsibility of the Surgeon. The next and the most important factor involving the medical profession is the responsibility of the surgeon in the care of the injured patient. First of all, he should be available when assigned as a responsible surgeon to a hospital emergency room. He should accept his assignment and his responsibility without question, and should see the patient and examine him immediately upon admission to the hospital instead of directing therapy by telephone or allowing an inexperienced person to take over.

Most victims of accidents have injuries involving many areas, each needing the care of a specialist, and it is the coordination of the team of specialists which is most important in working out the proper care of the patient with multiple injuries. The most serious and urgent injury usually will determine which specialist will be the captain of the team and will direct the general care of the patient. It makes little difference whether the responsible surgeon is a general surgeon, orthopedic surgeon, neurosurgeon or plastic surgeon, so long as he assumes responsibility, directs the proper

evaluation of injuries in each specialty, and sees to it that the proper priority is given to each injury. Fortunately, nowadays this philosophy is well understood in most hospitals, and rarely does the patient suffer as the result of a narrow-minded specialist who does not allow any cooperative efforts by others to interfere with him.

The very fact that the victim of an accident will suffer from injuries in many fields indicates that the surgeon who expects to treat trauma should have a broad knowledge of trauma in every field and should cooperate with specialists in other areas.

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The Ambulance

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TRAUMA has been with us since antiquity and will be here at the millennium. Since the first injury was sustained by man, it has been necessary to transport him to a place where he could be fed and sheltered, and his wounds treated.

The quality of transportation of the injured in our modern civilization leaves much to be desired. Although proper methods of transporting the injured have been published for many years in the Boy Scout Handbook and the First Aid Manual of the American Red Cross, many who are engaged in transportation of the injured fail to observe these fundamental procedures.

The present role of the morticians in transporting the injured has been a natural development. Although they were primarily interested in transporting the dead, their vehicles were the best available for transporting the sick and injured. Actually, the latter has remained more or less a sideline.

In recent years independent ambulance companies have been formed. Their sole duty is the transportation of the sick and injured.

For many years transportation of the injured has consisted essentially of putting the victim on a cart and transporting him to the hospital as quickly as possible. No effort was made to evaluate the injuries nor to follow any of the principles which would make for a safer ride. This situation, however, has gradually changed in many areas because of the efforts of the American Red Cross, morticians and the medical profession. Distinct efforts have been made to educate the ambulance attendant as to the fundamental principles of transporting the injured.

For the past fifteen years Flint, Michigan has had an ordinance requiring ambulance attendants to be certified as to their proficiency in transporting the sick and injured. By mutual cooperation between the morticians, independent ambulance companies, the city health officer and the local Committee on Trauma of the American College of Surgeons the quality of the transportation of the injured in this vicinity has progressively improved. During the past two years there has been not a single badly transported injured person brought to Hurley Hospital by the participating ambulance companies. This has been accomplished by education, ordinance control and continuous checking as to quality.

In many cases, poor transportation of the injured can do as much or more harm than the original accident. It can also influence the type of definitive management and the ultimate result of treatment of a specific injury. It, therefore, behooves the medical profession as well as the general public to insist that those engaged in transportation of the injured be properly qualified.

An educational program is needed to educate the ambulance attendants as to proper methods of transportation. This may be done on a voluntary basis, but is best accomplished by legislation. Ordinances are in effect in many cities. Louisiana (1938) and Massachusetts (1957) have statutes pertaining to the transportation of the injured. However, the great majority of those engaged in transportation of the injured are neither regulated nor qualified.

At present those most proficient in transportation of the injured are the rescue squads of the armed forces medical departments and the American Red Cross. There are other well organized private rescue squads. It is reasonable to expect that anyone making a living from transporting the injured should be well qualified.

The following is a model statute which might be enacted to improve the quality of transportation of the sick and injured person:

The Ambulance

DEFINITION

AN ACT TO REGULATE THE OPERATION OF VEHICLES ENGAGED IN THE BUSINESS OF TRANSPORTING SICK OR INJURED PERSONS; DEFINITION; TO PROVIDE QUALIFICATIONS OF DRIVERS AND ATTENDANTS; TO REQUIRE CERTAIN EQUIPMENT; TO REQUIRE INSPECTION OF EQUIPMENT; TO REGULATE THE SPEED OF AMBULANCES; TO PROVIDE PENALTY FOR THE VIOLATION OF THIS ACT.

SECTION I. FOR THE PURPOSES OF THIS ACT, AN "AMBULANCE" SHALL BE DEFINED TO INCLUDE ANY AND ALL VEHICLES MAINTAINED AND OPERATED IN THE BUSINESS OF TRANSPORTATION OF SICK OR INJURED PERSONS.

It is important that the definition include the phrase "maintained and operated in the business of transportation of sick or injured persons." Since any and all vehicles may be construed to mean vehicles operated on land, sea or air, a special situation might arise necessitating the use of a specific type of vehicle for rescue work which is not necessarily nor ordinarily used in the transportation of the injured. In such a case, such a person might hesitate to rescue someone under fear of being penalized by the law. This may seem rather farfetched, but the situation could arise.

SECTION II. IT SHALL BE UNLAWFUL FOR ANY PERSON TO CONDUCT, MAINTAIN OR OPERATE AN AMBULANCE WHILE TRANSPORTING ANY SICK OR INJURED PERSON UNLESS SUCH AMBULANCE SHALL BE UNDER THE IMMEDIATE SUPERVISION AND DIRECTION OF A DRIVER OR ATTENDANT WHO HAS A CERTIFICATE EVIDENCING SUCCESSFUL COMPLETION OF A COURSE EQUIVALENT TO THE SENIOR RED CROSS COURSE IN FIRST AID.

Anyone engaged in transporting the sick and injured should be familiar with the principles laid down by the Senior Red Cross course in first aid. In addition, he should be particularly proficient in the proper methods of immediate care and transportation of those people who have sustained injuries common to traffic accidents. The following is a teaching outline used in the ambulance attendant training program at Flint, Michigan.

Position of Victim

Keep patient in comfortable position, head level with body, until the nature of the injury is known.

Examination

Look for and treat serious bleeding and respiratory arrest. Find and splint all fractures and dislocations. Cover wounds and burns with sterile dressings.

Shock

Maintain body heat. Transport comatose patient in supine position. Handle gently.

Control of Bleeding

Direct pressure over wound. Know pressure points. Use tourniquet as last resort. A poorly applied tourniquet may cause great damage. Place sterile dressing over all open wounds and bandage in place.

Internal Injuries

Maintain body heat. Keep victim perfectly quiet. Move only when absolutely necessary and in supine position. Turn head to one side if victim is vomiting. Handle gently.

Failure of Respiration

If victim is not breathing, start artificial respiration immediately. Use oxygen when victim starts to breathe. Severe injuries of the chest require specialized attention.

Fractures

Splints should be used in all suspected fractures during transportation of victim. Fractures may be either open or closed.

Closed Fractures. 1. Fracture of the upper part of the arm: Bandage arm securely over chest or use two wood fiberboard splints, one on each side of arm.

2. Fracture of the forearm: Splint with pillow or use wood or fiberboard splints. Folded magazines are useful.

3. Fracture of the wrist: Apply wood or fiberboard splints to palm and under side of lower part of the arm.

4. Fracture of the upper part of the leg: Apply Thomas half-ring splint with traction at ankle. Support splint so heel does not rest on cot. Beware of pressure.

5. Fracture of the lower part of the leg: Employ Thomas half-ring splint with traction at ankle. A pillow or fiberboard splint may also be used. Beware of pressure.

6. Fracture of the ankle: Splint with pillow or fiberboard.

7. Fracture of the back: Transport patient in position as when found (face up or face down). Preserve normal arch of spine.

8. Fracture of the neck: Apply continuous traction on head with hand. Transport patient in supine position with support under neck. Fractures of the back and neck should be handled very carefully with head and body as one unit.

9. Fracture of the lower jaw: Bandage under chin and over top of head to hold lower jaw in position against upper jaw.

10. Pelvic fractures: Transport patient on back; bind knees and ankles together. Some patients are more comfortable with pillows under the knees.

11. Fractures of the joints: Patients with fractures of the elbows, knees and ankles should not be moved. Splint the fracture with pillow in the position found.

Open Fractures. In an open fracture the broken bone sometimes presents through the wound to the surface of the skin. These fractures are often more serious than the closed type. Check for serious bleeding or shock, and treat. Wounds should be covered with sterile dressings and splinted as in closed fractures. Pillow splints are used if the wound contains foreign material. Do not push protruding bones inside.

Thoracic Injuries

Fractures of the ribs: If no internal injury is suspected, the patient is moved on his back with head and thorax slightly elevated.

Internal thoracic injuries may follow fracture of the ribs or external puncture. Cover open and sucking wounds with sterile gauze so that outer air cannot enter chest cavity. Place victim on injured side and make him as comfortable as possible. Sandbag any areas showing paradoxical motion.

Dislocations

The pillow splint is comfortable for transportation of the patient.

Burns

Cover burned areas with sterile dressings and bandage in place. If large area of body is burned, wrap in clean sheet.

Injuries to the Head

Cover all open wounds with sterile dressings. Avoid pressure at site of injury. Transport victim in prone or side position. If supine position is used, watch for plugging of nose and mouth with secretions.

SECTION III. ALL VEHICLES MAINTAINED, OPERATED OR USED AS AMBULANCES IN TRANSPORTATION OF SICK OR INJURED PERSONS SHALL BE EQUIPPED WITH A FIRST AID KIT OR BOX EQUIVALENT TO THE 24 UNIT AMERICAN RED CROSS KIT, TRACTION SPLINTS AND BANDAGES COMMONLY USED FOR THE IMMOBILIZATION OF LONG BONES, AND THE NECESSARY TEMPORARY TRACTION EQUIPMENT, OR SUCH SPECIFIC ITEMS AS DIRECTED BY THE STATE HEALTH COMMISSIONER OR OFFICER.

The following is a list of equipment required by the ambulance companies of Flint, Michigan: (1) Large A.B.D. pads, (2) soft roller bandages, (3) two inch gauze bandage, (4) four inch gauze bandage, (5) four inch compress bandages ("Ace"), (6) two inch compress bandages (Ace), (7) adhesive compress, (8) absorbent gauze compress, (9) ammonia ampules and paper cups, (10) ammonia inhalants, (11) four by six yard gauze bandage, (12) tourniquet, (13) triangular bandage, (14) tongue blades, one padded for mouth gag, (16) bandage shears, and (17) safety pins.

Splints to be included are as follows: (1) hinged half ring splints (for leg) with web strap for ankle hitch, (2) two 18 inch beaverboards (covered and padded), (3) two 15 inch beaverboards (covered and padded), (4) not required, but very helpful are back boards of ¾ inch plywood, made in two sections and hinged, each section 2 by 3 feet, with hand holes cut in each section.

SECTION IV. ALL VEHICLES MAINTAINED AND OPERATED AS AMBULANCES SHALL BE INSPECTED AT LEAST TWICE EACH YEAR BY THE COUNTY HEALTH COMMISSIONER OR OFFICER, OR A DEPUTY DESIGNATED BY HIM, OR BY SOME OTHER PERSON DESIGNATED BY THE STATE HEALTH DEPARTMENT TO MAKE SUCH INSPECTION AS HEREIN PROVIDED. THE PERSON MAKING SUCH INSPECTION SHALL DETERMINE WHETHER OR NOT THE AMBULANCE IS EQUIPPED WITH THE NECESSARY ITEMS ABOVE REQUIRED AND SHALL DETERMINE WHETHER SUCH EQUIPMENT IS IN PROPER AND GOOD CONDITION FOR USE.

SECTION V. ANY PERSON WHO OPERATES AN AMBULANCE WHILE ACTUALLY TRANSPORTING THE PATIENT SHALL CONFORM TO ALL LAWS IN RESPECT TO SPEED AND OTHER DRIVING BEHAVIOR; FURTHERMORE, NO DRIVER AND OTHER

ATTENDANT SHALL DO ANY INTENTIONAL ACT OR THING TO INCREASE THE SERIOUSNESS OF THE ILLNESS OR THE SEVERITY OF THE INJURY OF ANY PERSON BEING TRANSPORTED BY THEM. NOR SHALL THEY OMIT, NEGLECT, AND/OR REFRAIN FROM DOING ANY ACT OR THING TO PROPERLY AID SUCH ILL OR INJURED PERSON.

The latter portions of this section seem to be necessary. It is of no value to educate the ambulance attendants as to the proper methods of transportation if they are not required to utilize their natural knowledge.

Opinions have been expressed by various groups regarding the necessity of speed in transporting the injured. The general impression among lay people is that speed is necessary in saving lives. The opposite view is expressed by some members of the medical profession who believe that the sirens should be removed from the ambulances and all traffic and speed regulations should be obeyed even to the point of waiting for red lights. The proper approach to this problem lies somewhere between these two extremes. Prompt, immediate care may be vital, but speed merely increases the hazard of accident.

In most areas ambulances are considered emergency vehicles and by law are allowed certain privileges in driving behavior. For example, they are allowed to exceed the speed limit and pass through red lights whenever the emergency arises. This is probably justified while the ambulance is going to the scene of the emergency.

In a series of 2,500 consecutive ambulance runs reviewed by us, haste in transporting the injured was unnecessary in 98.2 per cent. There would have been no difference in the outcome of 2,455 patients had they been transported according to standard traffic regulations. In 1.8 per cent expeditious handling was considered necessary, but a speeding ambulance could have increased the severity of the injuries.

In only forty-five instances was the time interval between the accident and the arrival at the hospital considered to be significant as far as the patient's course was concerned. Expeditious handling of these victims was desirable, but the speeding ambulance was considered unnecessary. In nine of these victims of accidents, a wild, weaving, siren-screeching ride to the hospital might have produced death or permanent invalidism. In the other thirty-six victims, the degree of shock might have been increased by a rough ambulance ride.

In only one case out of the entire 2,500 would a moderate delay in transportation have resulted in death, and yet this person was transported without the use of excessive speed and she survived.

During the actual transportation of the injured the ambulances should obey the local speed laws. They should have the right-of-way in traffic and at red lights and retain the use of their sirens for identification.

SECTION VI. ANY PERSON WHO VIOLATES ANY PROVISION OF THIS ACT SHALL BE DEEMED TO BE GUILTY OF A MISDEMEANOR AND UPON CONVICTION SHALL BE REQUIRED TO PAY A FINE NOT TO EXCEED ONE HUNDRED DOLLARS ($100.00) OR SHALL BE SENTENCED TO SERVE A JAIL TERM OF NOT MORE THAN NINETY (90) DAYS, OR SHALL BE REQUIRED TO PAY A FINE AND SERVE A JAIL SENTENCE, AT THE DISCRETION OF THE COURT.

This is simply a standard misdemeanor penalty in Michigan.

The sick and injured deserve a safe ride to the hospital.

Transportation of the Injured

OSCAR P. HAMPTON, JR., M.D., *St. Louis, Missouri*

IF you sustained multiple fractures of the lower extremities in a traffic accident in your own city or town, do you believe you would be cared for at the scene of the accident and transported to a hospital in a manner conducive to your best interest? This is a paraphrase of a discerning question first propounded several years ago by Drs. Robert H. Kennedy and George J. Curry in a questionnaire surveying transportion of the injured in a number of the larger and smaller cities of the United States. The answer to this question from many areas was emphatically no. This situation is of great concern to the many Committees on Trauma of the American College of Surgeons and their Sub-Committees on Transportation of the Injured. A major objective of these Committees is improvement in emergency medical care for casualties on the highways and city streets of America.

What constitutes adequate emergency medical care at the scene of the accident depends in a large measure upon the injuries sustained by the traffic casualty, injuries which are obvious to trained ambulance and law-enforcement personnel. It always includes judicious handling of the casualty. It may embrace some simple procedure to restore or preserve an airway; the control of hemorrhage by compression dressing or at times a tourniquet; the dressing of wounds; the splinting of fractures; and other procedures to combat shock (preservation of body heat, elevation of the foot of the litter or stretcher). These are the same procedures for saving life and limb provided so effectively by Medical Aid men of the United States Army on the battlefields of World War II and in Korea. If these measures are possible on the battlefield under stress of combat, surely they are feasible on our well paved streets and highways.

Casualties should not be placed hurriedly in the first available vehicle and rushed pell mell to a hospital. On the contrary, they should be held at the scene of the accident until personnel adequately trained in first aid arrive in an adequate vehicle (usually an ambulance) for transporting the injured; adequate emergency care should be rendered the casualty. Then, and only then, is he ready for transportation to a hospital.

Once again, speed is seldom if ever of the essence. The ambulance should proceed to a hospital with due caution, obeying all traffic regulations. To rush the casualty to the hospital at breakneck speed while ignoring traffic signals and regulations only endangers the lives of many pedestrians and occupants of other vehicles, and should be prohibited by law.

OUTLINE OF ADEQUATE EMERGENCY MEDICAL CARE FOR TRANSPORTATION OF THE INJURED

Restoration or Preservation of Airway

While such standard surgical procedures as intubation and tracheostomy are out of the question as part of emergency medical care at the scene of the accident, a few simple maneuvers may be life saving. False teeth or other intraoral foreign bodies may be removed. The tongue may be held forward and protruding from the mouth to avoid blocking the airway. Helpless patients bleeding into the mouth and nose or those who are vomiting should be placed in a semi-prone position so the nasopharyngeal blood and secretions and vomitus may run out of the mouth and nose. In this way, the hazard of aspiration with obstruction of the airway is reduced. (This will be discussed in the section on unconscious patients.)

Control of Hemorrhage

Hemorrhage of all severities may be controlled as a rule by a compression dressing, a bulky dressing applied firmly with a material with some elasticity such as a cotton elastic

bandage, cut stockinet, or even rolls of crepe paper.

Hemorrhage uncontrolled by such a dressing and which appears to endanger life may be arrested by a tourniquet properly applied. It must be applied tightly. A tourniquet must arrest arterial flow as well as venous flow of blood. Merely to obstruct the latter does more harm than good as it promotes further bleeding.

Dressing of Wounds

Every open wound of significant size deserves an occlusive dressing. So-called antiseptics or antibiotics should not be applied to the wound. The mere application of a sterile dressing (or a dressing of clean material if sterile material is not available) prevents further bacterial contamination of the wound and helps control hemorrhage.

Emergency Splinting for Transportation

Effective emergency splinting of fractures for transportation of the patient to and even within a hospital is a highly significant procedure in determining his eventual rehabilitation. Failure to provide emergency splinting while the patient is being moved and transported to the hospital may result in laceration of major arteries and nerves with resulting danger to the life or function of the limb, or may cause a fragment to tear through the soft parts and skin, creating an open fracture. Infection may become established and lead to prolonged morbidity and even endanger life and limb.

The objectives of emergency splinting are the prevention of additional damage to the soft parts by fragments of bone, the relief of pain and comfortable and safe transportation. Effective emergency splinting minimizes or prevents "wound shock" and is an important step in resuscitation.

Emergency splinting may be provided with standard or improvised splints. Standard splints, if available, are the most effective, but if they are not available, various materials which usually are easily obtainable may be used to provide highly effective improvised emergency splinting and achieve its objectives. Lack of splinting material is seldom if ever an adequate excuse for the omission of emergency splinting.

The Upper Extremities. Shoulder, arm and elbow: Standard splinting is simple. The extremity is placed in a sling with the elbow usually at a right angle and then is bound to the chest by means of a bandage or another sling. (Fig. 1.)

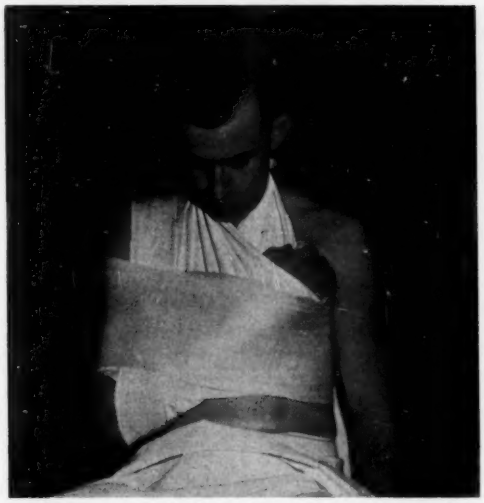

FIG. 1. Emergency splinting for a fracture of the shaft of the humerus. The acute angle at the elbow is unnecessary. Usually the elbow is flexed to only 90 degrees.

Improvised splinting may be provided by turning up the patient's shirt in front and pinning it to the shirt so that it serves as a sling. The extremity is then bound to the chest with any available material. Even rope or a bandage of torn sheeting would suffice.

Forearm, wrist and hand: Standard splinting may be provided on a metal cock-up or cock-down splint, but improvised splinting, using a magazine or a heavy newspaper encircling the forearm and hand or a single board held in place with a bandage or adhesive tape, is usually equally effective. A sling always adds to comfort.

Patients with injuries of the upper extremity only are usually more comfortable during transportation in the sitting rather than in the recumbent position.

The Lower Extremities. The thigh (femur): Standard splinting for fractures of the shaft of the femur is provided by fixed traction utilizing a Thomas or a hinged half-ring splint. (Fig. 2.) Traction is obtained by means of a hitch about the foot which is tied to the end of the splint. The slings on which the extremity rests may be towels or bandages of any kind. Only moderate traction is desirable. The end of the

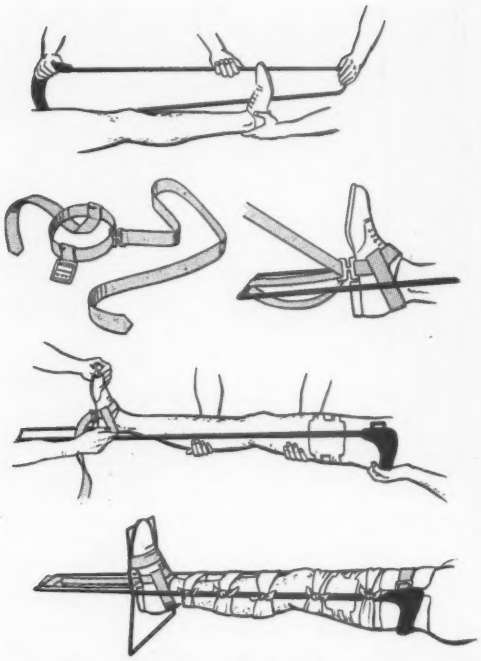

FIG. 2. The application of fixed traction, using a half-ring leg splint and a traction hitch, as emergency splinting for a fracture of the shaft of the femur.

splint must always be elevated so that the heel does not touch the stretcher.

Coaptation splinting using previously prepared or improvised board splints is also quite effective. It may be provided with two or three board splints, well padded at the ankle and the knee. The lateral board must extend to the axilla and be bound securely to the trunk in order to immobilize the hip. (Fig. 3, top and middle.) A medial board and a posterior board extend from the upper part of the thigh to below the foot.

The leg: Coaptation splinting is preferable to fixed traction for fractures of the bones of the leg. Medial and lateral boards, preferably supplemented by a third board placed posteriorly, each well padded, extend from the upper part of the thigh to below the foot. (Fig. 3, bottom.)

A pillow splint provides another form of improvised splinting for fractures of the bones of the leg. A pillow may be merely bandaged about the leg but the splinting is better if a coaptation board is placed on each side. Effective splinting may also be obtained by a

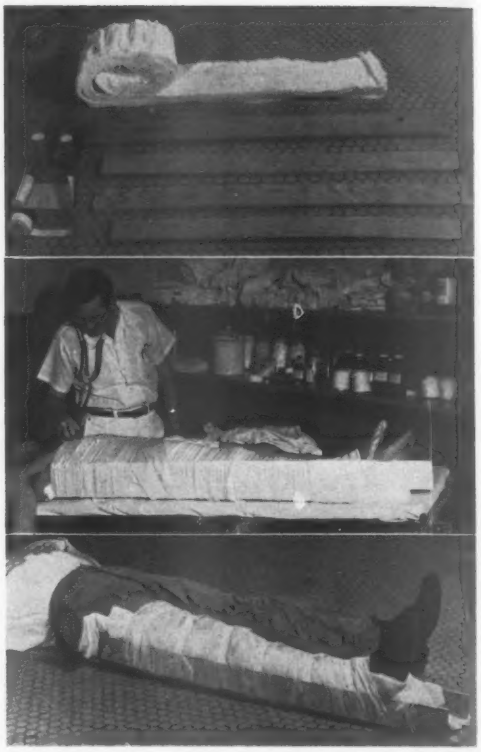

FIG. 3. *Top,* material for coaptation splinting for fractures of the femur or the bones of the leg. *Middle,* coaptation emergency splinting for fracture of the femoral shaft. Note that the long board on the lateral side of the leg extends almost to the axilla and is securely bound to the trunk. *Bottom,* coaptation emergency splinting for a fracture of both bones of the leg. (Top and bottom photographs from: HAMPTON, O. P., JR. Civil defense; emergency treatment of casualties with major open wounds, blast, and crush injuries. *J. Missouri M. A.,* 49: 391–409, 1952.)

folded blanket bandaged about the extremity. (Fig. 4.)

As a last resort for improvised splinting for fractures of the femur or bones of the leg, the injured extremity should be bandaged to the uninjured extremity at several levels.

The Spine. The cervical spine: In suspected injuries of the cervical spine the patient should be transported face up on a hard surface with a small rolled towel beneath the neck, and preferably with sand bags or other heavy material placed on each side of the neck. Flexion of the neck must be avoided.

The thoracic and lumbar spine: Patients

suspected of having injuries to these vertebrae should be transported somewhat in the position they are found. If the casualty is found face down, he should be lifted to a hard surface and kept face down. If he is found lying face up, he should be lifted to the stretcher in this position. Flexion of the spine is always avoided.

Open Fractures. The emergency management of open wounds including those of open fractures is the application of a sterile dressing or the cleanest dressing available. No antiseptics or antibiotics should be placed on or in the wound. If a fragment protrudes through the skin, it should be allowed to remain protruding and merely be covered with the dressing. In applying emergency traction splinting to the lower extremity, the amount of traction should be kept below a point which would cause the fragment to be pulled back into the wound.

Unconscious Patients. These patients are preferably transported in the semi-prone position so that nasopharyngeal blood and secretions will run out of the mouth and nose and not be aspirated. Other positions are chosen only when demanded by concurrent injuries of other parts of the body. Open wounds of the head are merely covered with a sterile or clean dressing.

Thoracic Injuries. Patients with these injuries are transported face-up and in the position apparently most comfortable and most favorable to adequate respiration. This usually is the semi-sitting position.

The quality of emergency medical care and transportation of the injured should be not only the concern of every local and regional Committee on Trauma but it also should be the concern of every practicing physician. A concerted effort on the part of each individual physician, the organized medical groups and the local medical societies can achieve tremendous improvement in these facets of the care of the injured. On the contrary, lethargy on the part of the profession in effect condones poor emergency medical care which in turn may jeopardize or render useless skilled definitive management of these patients within the hospital. Dr. Curry, in the Oration on Trauma at the Clinical Congress of the American College of Surgeons in 1958, stated succinctly: "Successful definitive management and ultimate rehabilitation of the violently injured are intimately dependent upon initial handling

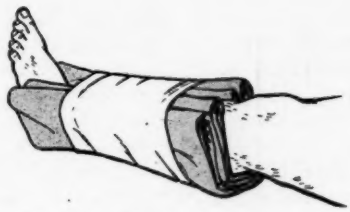

FIG. 4. Artist's drawing to show the use of a folded blanket as an emergency splint for fracture of both bones of the leg.

at the site of the accident and during transportation to the hospital. Indeed, subsequent deformity, prolonged illness or even death may be predetermined during this brief interval."

Emergency medical care and transportation of the injured are carried out best in those communities which have ordinances regulating the equipment on ambulances and the training of ambulance personnel. The following cities now have such ordinances: San Francisco; Minneapolis; Syracuse; Cincinnati; Philadelphia; Flint, Michigan; Pontiac, Michigan; Butte, Montana; and New Orleans. Massachusetts and Louisiana have state statutes covering this problem.

Each of these ordinances (or state statutes) embraces or should embrace several principles. Each individual, corporation, or responsible governmental agency which purports to transport the injured on the streets and highways must equip the ambulance or comparable vehicle with the necessary materials for dressings, for splinting of fractures, and other material for effective emergency medical care. In addition to the driver, each ambulance must have an assistant (or a police officer at the scene) because emergency medical care including splinting for transportation is a two-man job. All ambulance personnel and law-enforcement officers who may participate must have received training in first aid and emergency medical care equivalent to that of the senior or advanced American Red Cross course; attendance at refresher courses at stated intervals (one to two years) is required. Training must be put to use by actual provision of emergency medical care at the scene of the accident. Finally, the ordinance must carry a penalty clause for failure to comply by either the ambulance personnel or those responsible for the ambulance. An ordinance without a penalty clause may be ignored.

Until recently the American College of Surgeons was the only large national organization continually active in efforts to improve emergency medical care on our streets and highways, efforts which to date have been attended with indifferent success. Now other groups have become allied in this effort. The National Safety Council, the American Association for the Surgery of Trauma, and the American College of Surgeons have joined hands in a "Joint Action Program" (discussed in some detail in another paper in this symposium). One of the important facets of this coordinated activity concerns transportation of the injured.

The National Safety Council annually submits a group of questionnaires collectively called the Annual Survey of Traffic Safety Activities to the heads of governments in many cities, counties and states. By means of data from these questionnaires, the National Safety Council evaluates accident-prevention activities in each locality and is able to determine what others are needed.

In the package comprising the Annual Survey of Traffic Safety Activities forwarded in December 1958, a questionnaire concerning transportation of the injured was included. This questionnaire was formulated by representatives of the National Safety Council and the Committee on Trauma of the American College of Surgeons. Data to be obtained from this questionnaire should be exceedingly valuable to everyone concerned with improvement in the quality of transportation of the injured. The organizations comprising the Joint Action Program will have factual data to show which communities are and which are not making a sincere effort in this direction. The beneficial effects of ordinances and statutes regarding ambulances and the training of ambulance personnel undoubtedly will be made crystal clear. Heads of government should be made cognizant of the prevailing situation in their respective communities in comparison with other communities of comparable size and with comparable problems. It seems reasonable that many in whose areas emergency medical care is poor or non-existent will be stirred from their apathy and will initiate proceedings directed toward providing effective and life-saving emergency medical care. Committees on Trauma of the American College of Surgeons will have factual data on which to base programs designed to achieve that objective. The entire medical profession, individually and through local, state and national medical societies, also may be stirred toward definite action designed to permit each physician to answer: "Yes, if I or a member of my family as a traffic casualty on our streets receive multiple fractures and wounds, excellent emergency care will be provided and transportation to a hospital will be all I could ask."

Preliminary Management of Traffic Casualties

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FAULTY first aid or transportation of the injured may vitiate the effects of the best of later treatment and predetermine the quality of the final result. It is less well recognized, but no less true, that defective preliminary management of an injured patient in a hospital emergency ward can have equally disastrous consequences.

The traffic casualty usually has little choice of surgeon or hospital, but upon arrival at a modern hospital he should have immediate access to the best facilities and surgical talents available in that hospital. The experienced surgeon who appreciates the maturity of judgment and organized rapidity of action often required for salvage of a critically injured patient may well reflect upon whether these conditions prevail in his own institution.

The injuries produced by modern vehicles are seldom single or simple. Nevertheless, transportation facilities have been so improved that more and more persons with complex and serious surgical problems are surviving the trip to a hospital. Here it is common for them to be received and nursed through the early and often critical stages of examination, resuscitation and preparation for definitive treatment by an inexperienced junior member of the intern or resident staff. In another article in this issue [1] Johnston points out that the management of trauma, as an entity, has been generally neglected in the undergraduate phases of medical education. Neither the intern nor the junior surgical resident usually assigned to accident ward service has had the time or opportunity to gain sufficient experience to make him competent in the management of serious or multiple injuries. His call for help must climb, sometimes uncertainly, up a surgical seniority ladder until eventually competent help and advice arrives on the scene. Some such lag period is inevitable and often of small import. At times, however, a few moments' delay in the implementation of some simple but urgent measure may spell the difference between life and death. Any avoidable mortality from trauma is excessive.

It is not the fault of an inexperienced junior medical officer that he is assigned to the accident ward for the primary purpose of attending to minor problems, that temporarily he must do the best he can upon the unexpected arrival of a serious problem, that he may fail to recognize quickly the urgent requirements of various injuries, and that by errors of omission or commission he may invite disaster. Faced with a serious trauma problem he must, until help arrives, steer a course predicated upon the knowledge absorbed as an undergraduate, a pitifully small amount of practical experience, and whatever specific instructions in the care of trauma he may have received from his current surgical mentors. Consequently, it should be an obligation of every surgical staff to provide instructions reflecting fundamental concepts in the care of trauma for the junior officers who man their receiving and accident wards. These should emphasize not only what should be done but also what should not be done, and why.

Glenn, in a discussion of the management of multiple injuries [2], listed specific suggestions for the preliminary care of injured persons which are worthy of being posted in a prominent place on the wall of every accident ward:

"1. Adjust the patient's position (a) to give him an adequate airway, (b) to compensate for blood loss, and (c) to prevent aspiration of vomitus.

2. Remove all clothing and inspect the entire body surface before anything else is attempted.

3. Make a complete and thorough physical examination so that no injury can be over-

looked, and at the same time establish a baseline for comparing changes that may follow.

4. Make only the simplest adjustments when necessary and use only temporary measures on injured parts, i.e., additional dressings to large wounds, temporary splints, and position support.

5. Conserve body heat with light blankets or such measures as may be available both during and after evaluation.

6. Administer fluids to prevent or combat shock. Dextrose in saline should be started immediately, followed by plasma as soon as it is available and finally by whole blood when cross matching has been completed. The lapse of time before administration of whole blood should be as short as possible. In most hospitals this can be accomplished within two or three hours.

7. Specific examinations, especially x-ray, should be done with the least possible disturbance to the patient. For patients with multiple injuries portable x-ray equipment may be preferable to shifting the patient from stretcher to fluoroscopic table, but this must be left to the physician in charge. Improved x-ray facilities now permit plates to be taken or fluoroscopy to be carried out with very little further trauma to the patient.

8. During the period of examination, when blood pressure levels are likely to be low, oxygen therapy will prove beneficial in many cases. The use of vasocontractors to elevate blood pressure during an examination usually results in further blood loss or increased shock.

9. Nothing should be given by mouth.

10. An indwelling urethral catheter will furnish additional information on the genitourinary tract immediately as well as provide a constant record of urinary output."

It would be difficult to improve on these suggestions which cover the essential points in the assessment of injury, and it is safe to speculate that preliminary management which adheres to the sense of these suggestions will be sound treatment even in inexperienced hands. However, the traffic casualty may have sustained injuries to any or all systems of the body, and certain measures beneficial to some may be detrimental to others. Recognition of this point and consideration of the potential disadvantages as well as the advantages of specific measures are of great importance to the prevention and correction of shock, which is the cumulative product of all the injuries that may be present.

The seriously injured traffic casualty is in impending or established shock when he arrives at a hospital. Bits of knowledge about such shock phenomena as the sludging and sequestration of blood or the influences of protein catabolins upon capillary permeability will be of little practical help in the prevention or correction of this undefinable systemic response to trauma. Successful treatment is more likely to depend upon recognition that oxygen deficiency is the fundamental factor common to shock from all causes, and that the basic objective of all shock treatment is to increase the amount of oxygen available for use by the body tissues. Death from shock results ultimately from cerebral anoxia. The prevention and correction of shock revolves around the supply, intake, alveolar transfer and vascular transport of oxygen, primarily to the brain but also to the hepatoportal and renal mechanisms. To the intern accepting this practical, if incomplete, concept of shock, the treatment measures deserving of high priority should be immediately apparent.

The *oxygen supply* will be augmented. The administration of pure oxygen by mask or catheter increases the oxygen content of arterial blood to an appreciable degree and somewhat reduces the harmful effects of a reduced circulating blood volume.

The *oxygen intake* will not be overlooked. A patent airway will be maintained by frequently repeated evacuation of blood and mucus secretions from the mouth, throat and upper respiratory passages, by prevention of prolapse of the tongue, or by the insertion of an airway to splint a distorted trachea. When patency cannot be maintained otherwise, recognition that asphyxiation can kill as rapidly as cardiac arrest will encourage consideration of tracheostomy before it is too late.

Oxygen transfer across the alveolar walls will be recognized as necessary to survival and the state of pulmonary ventilation will not be overlooked. A sucking wound of the chest wall will be sealed quickly by an adhesive or other reasonably airtight dressing. Re-expansion of a collapsed lung will be promoted by early aspiration of a tense pneumothorax. The flail segment of a crushed chest will be stabilized quickly by supportive dressings or traction.

These are the most common products of

trauma which may kill in minutes and which demand the highest priority in treatment. They cannot often await the arrival of an expert, but usually must be corrected, if at all, by the first physician on the scene. Once a supply, intake and pulmonary ventilation of oxygen has been restored, the final step in providing adequate tissue oxygenation depends upon reconstitution of an adequate circulating blood volume to function as the transport vehicle.

Ancillary measures in the management of shock should be evaluated for their effects upon the various existing injuries before being carried out. To be valid they should be consonant with the basic objectives of shock therapy, i.e., to increase the amount of oxygen available to the essential body tissues. However, a procedure which is of benefit to one injury may have harmful effects upon another. The potential merits and demerits of each step in shock therapy warrants analysis prior to implementation.

As simple a matter as the patient's posture may be a two-edged sword. The orthodox "shock" position, with the head lowered, is designed to facilitate the flow of blood to the brain by gravity, but a person in deep shock has relatively little blood left to flow downhill in this direction from his constricted peripheral vascular tree. In the presence of an injury to the head, the head-down position may have undesirable effects by its production of increased intracranial pressure; and in the presence of a disabled respiratory mechanism or hypoventilation from any cause, this position, by shifting the weight of the abdominal contents against the diaphragm, may virtually abolish all semblance of an adequate respiratory exchange. Standard posture for preventing prolapse of the tongue or aspiration of vomitus is with the slightly lowered head turned to the side. However, in the presence of a cervical injury this may result in irreparable damage to the spinal cord. It is clear, therefore, that even the simplest of measures for combating shock should not be used by rote, but only according to the individual dictates of the problem at hand.

Drugs are of doubtful value and at best are absorbed inadequately from the vasoconstricted peripheral tissues. When necessary, they should be given by vein. Serious shock is not often attended by severe pain, and comfort can usually be provided by temporary splinting of injured parts, and position support. Recovery is synonymous with restoration of top-flight performance by the brain stem centers so that the depressant effects of morphine and other narcotics should be scrupulously avoided. Restlessness, excitement or emotional disturbances may be controlled by small intravenous doses of barbiturates.

The use of vasocontracting drugs to combat the hypotension of post-traumatic shock almost always does more harm than good, and is usually followed by deeper shock and increased bleeding within a very short time following a transient elevation of the blood pressure. This is a logical sequence, for in the face of an already contracted peripheral vascular tree further vasocontracting influences serve but to reduce the capacity and depreciate the remaining effectivity of the visceral and cerebral vessels.

The body temperature of a patient in shock must be maintained. However, to raise the body temperature by heating or by bundling the patient in many blankets serves but to increase the fluid loss and increase the metabolic demand of the tissues. The patient in shock should not be heated but merely prevented from cooling.

Venipuncture should be done as quickly as possible, for the first teleological defense reaction to shock is peripheral vasoconstriction, which is reflected in a collapse of all superficial veins. A delay in the insertion of one or more needles into the available veins of a seriously injured patient soon may necessitate a cut-down procedure which consumes some of the precious moments that may be essential to survival. Dextrose in saline, plasma or a plasma expander and finally suitable whole blood should be infused in that order as quickly as each can be obtained. Whole blood replacement in established shock should not be administered in homeopathic quantities but as much and as rapidly as possible within the limits of a measure predicated upon the blood pressure response.

The depleted venous return peculiar to post-traumatic shock usually constitutes a dependable defense against overloading the heart by excessive transfusion, so long as the blood pressure is recorded frequently and the infusion rate decelerated as the pressure becomes elevated and stabilized. However, the physician should not overlook the fact that traffic accidents sometimes are precipitated by an acute cardiac episode. The superficial stigmas of

shock, especially when all out of proportion to the extent of the injury, should arouse a suspicion that these signs may be of cardiac origin. To treat a person with a disabled cardiac mechanism for shock may well prove fatal, and there is little excuse for such a mishap if the potential relationship between a heart attack and a traffic accident is kept in mind. The high venous pressure, bulging veins and defective action of a disabled heart are in sharp contrast to the low venous pressure, collapsed veins and regular cardiac rhythm of shock.

Hemorrhage must be controlled. However, with the increasing hypotension and peripheral vasoconstriction peculiar to progressing shock, the blood loss from extremity wounds almost always decreases spontaneously to a point where it can be controlled, at least temporarily, by a sterile pressure dressing and elevation of the wounded part. A large visible vessel with profuse hemorrhage may be caught with a hemostat prior to application of the dressing. Massive hemorrhage from a branch of the aorta may require heroic measures, but such a decision must await the judgment of an experienced surgeon. A tourniquet is almost never necessary. If one is applied prior to admission, it should not be removed until all supportive measures have been established and some semblance of stability has been restored.

Physical examination must be complete but gentle. Excepting massive hemorrhage and cardiac tamponade, the common products of trauma that may kill quickly enough to demand immediate attention have been outlined. Next in priority and importance are the less obvious lesions which may kill as surely, if not as quickly, as those which deprive the tissues of oxygen. The greatest danger to survival lies in a failure to recognize these lesions which in the early stages following injury often are occult, but which if untreated, augment and perpetuate shock by delayed hemorrhage or infection. Consequently, every system of the injured body must be evaluated in sufficient detail to establish a diagnosis, if possible, and to document a baseline for comparison with the findings of the repeated examinations usually required for recognition of the progressive changes produced by these primarily obscured or quiescent lesions. Of third priority are the injuries which endanger function but not life. Their cumulative effects contribute to shock, but temporization by splints and dressings is in order until life-saving measures have been successfully accomplished and the patient's condition stabilized.

The injured patient must be handled gently at all times. He may remain quiet without any apparent deterioration for several hours, only to be precipitated into irreversible shock when moved suddenly or his position changed. It is for this reason that special tests such as x-ray examinations often should be carried out by portable facilities which can be brought to the patient, or the test deferred until his condition has been stabilized.

Great care and caution and the utmost in surgical judgment is required for the management of an injured patient who is unconscious. He must be presumed to have suffered an injury to the head and he may be in shock. Nevertheless, during the early period following admission, temporization and continuous scrutiny are in order. Shock treatment should be deferred until it has been ascertained that acute drug or alcohol poisoning is not present, for the occasional poisoned person is in simulated shock. However, like the patient with an acute cardiac disability, he may well die from energetic treatment for shock.

Information concerning the time relationship between accident and loss of consciousness is always valuable. Immediate unconsciousness, followed by a later clearing of the sensorium, is usually indicative of an injury to the head that is likely to recover spontaneously, but a delayed or gradual loss of consciousness suggests increasing intracranial pressure that may require decompression. Under any circumstances, the admitting officer will do well to satisfy himself with peripheral tests designed to localize the area of brain damage and to record the vital signs at regular and frequent intervals until expert help arrives.

He must also recognize the imminent danger of vomiting by the unconscious patient. Unless contraindicated by other injuries, a lateral recumbent position minimizes the risk of aspiration, but the head should not be lowered more than a small amount lest the intracranial pressure be increased unduly. The stomach should be evacuated and decompression maintained by an indwelling gastric tube to reduce the risk of aspiration of vomitus, to identify a poison, if present, and to prevent the further absorption of any poison present. Active treatment of associated injuries should be delayed as long as

reasonably possible in the hope that the situation will become clarified.

The foregoing discussion of some of the urgent problems peculiar to the accident ward has been prompted by sympathy for the junior medical officers who, from time to time, must face them and do the best they can with what they have, and by a growing but widespread recognition that the weakest link in many hospitals consists of inadequate accident ward facilities and personnel. Facilities can be purchased. Young surgeons cannot be trained but must be educated in the disciplines of trauma. The importance of adequate preliminary care of traffic casualties prior to definitive treatment brooks no argument. The over-all results will be the regard or ignominy not of the junior medical officers who man the emergency wards but of those who presume to teach them.

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Emergency-Room Service in Hospitals

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A FEW years ago injuries and other types of emergencies were neglected by most hospitals throughout the country. During recent years an intense interest in emergency work has developed due largely to programs instigated by two groups, namely, the American Association for the Surgery of Trauma and the American College of Surgeons through its Committee on Trauma. Too often in the past, emergency work in the hospital was assigned to inexperienced individuals.

THE NEED FOR EMERGENCY ROOMS

So many accidents and emergencies occur that every large hospital is now expected to have a competent Emergency Service. Specialized care for patients with complicated diseases or conditions can be assigned to a few hospitals in a major city providing the cases are not of the urgent type. However injuries and other emergencies are so urgent that it is undesirable to transport patients a long distance to certain centers. Accordingly, it is desirable, and in fact essential, for all large hospitals to have a competent Emergency Service.

Trends in the number of accidents do not reveal any decrease. This is another reason why hospitals must have adequate emergency service. In 1957 there were 95,000 accidental deaths and 9,600,000 injuries. These injuries as tabulated by the National Safety Council have been divided as follows:*

Place of Accident	Deaths	Injuries
Work	14,200	1,950,000
Motor-vehicle	38,500	1,400,000
Home	28,000	4,200,000
Public	17,500	2,150,000

* Death and injuries for the four separate classifications total more than the national figures because some deaths and injuries are included in more than one classification.

Although the data listed is not significantly greater than the accidents and injuries recorded for the previous year or two, there is no decrease. We doubt very much that there will be a significant decrease within the next several years except perhaps in deaths and injuries occurring in industry, in which there has been a definite decrease in the past several years. Since automobile manufacturers continue to stress speed in their product, and since such a huge percentage of the public has a craving for speed on the highways, we probably cannot expect much of a decline in this category. Accordingly, it is rather obvious that we must continue to have Emergency Services in all hospitals of the general type. It is probably not advisable for special hospitals such as tubercular hospitals and mental institutions, etc., to cater to accident and emergency work because a liberal list of personnel is required to carry on a good Emergency Service.

We all have become so accustomed to seeing reports of a pedestrian severely injured by an automobile that it is only by following-up an individual case through the days and weeks of treatment that one realizes what this means in terms of suffering, permanent disability and expense—if the patients survives at all. A newspaper clipping reported the severe injury of a seventy-one year old white man. Of particular interest was the next to last sentence which stated that [the driver] " . . . was charged with leaving the scene of an accident, drunken driving, and failure to yield the right-of-way to a pedestrian." This sentence may contain one of the great challenges of our era to the medical profession, encompassing as it does the entire field of the impact of our society on an individual and his response. Prevention of such catastrophes goes far beyond safety devices originating in Detroit—it implies a concerted effort to expose the underlying causes and a vigorous campaign for their prevention.

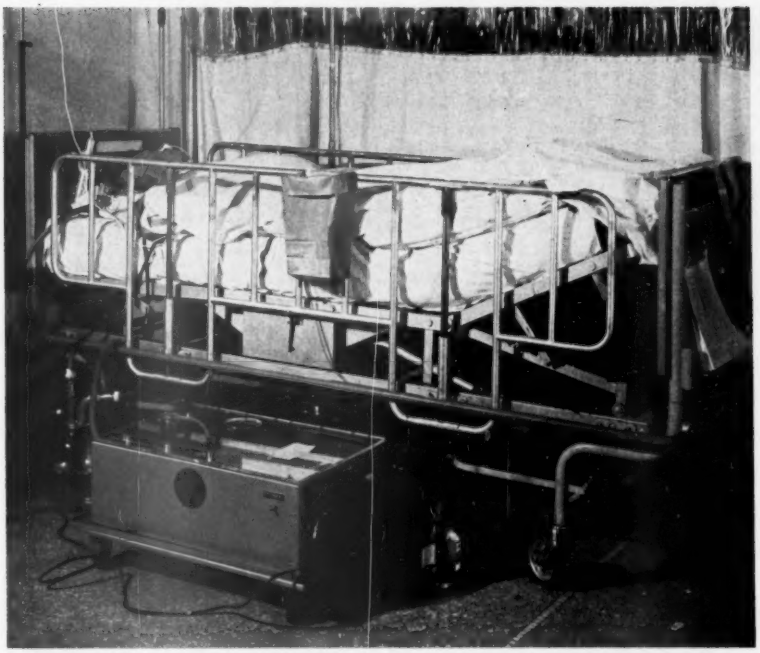

FIG. 1. This seventy-one year old white man sustained multiple, severe injuries when he was run down by an auto. Multiple fractures of the ribs resulted in poor respiratory exchange. Tracheostomy was performed and the patient was put on the Morsch respirator.

Twenty minutes after the accident the patient arrived at our Emergency Room. He was found to have the following injuries: (1) open fracture of the right tibia and fibula; (2) closed fracture of the left tibial plateau; (3) multiple fractures of the right ribs; (4) severe pelvic fractures; (5) laceration of the scalp; and (6) severe contusions and ecchymoses of the abdomen and right flank.

Twelve units of blood were required to bring the patient's blood pressure to 80 mm. Hg. Because of failure of the blood pressure to stabilize despite repeated transfusions and because of rapid increase of the ecchymoses of the abdominal wall it was thought that celiotomy was indicated. At operation a severely contused right kidney and a large hematoma of the anterior and right lateral aspects of the abdominal wall were found. There was no visible bleeding point. The open fractures were reduced after thorough cleansing of the wound. In view of persistent respiratory difficulty due to the multiple rib fractures tracheostomy was performed. After the patient reached the recovery room he was placed on the Morsch respirator. (Fig. 1.) A graph showing the fluctuations in systolic blood pressure during the twenty-four hours following operation is shown in Figure 2. The patients' condition was extremely critical for ten days after the accident. He slowly improved, however, and was finally taken off the Morsch respirator three weeks after the accident. The patient did fairly well during the next few days but died suddenly, approximately one month following the injury. Postmortem examination revealed severe bilateral bronchopneumonia as the cause of death. The total hospital bill amounted to $1,261.25; however, this is based upon very moderate charges for room, board, blood transfusions and drugs. The hospital cost would have been well over $2,000 in a private institution.

LOCATION AND PHYSICAL STRUCTURE OF THE EMERGENCY ROOM

Obviously the Emergency Room must be located at the rear or side of the hospital but in a position where it is readily accessible by ambulance or automobile. The rooms should

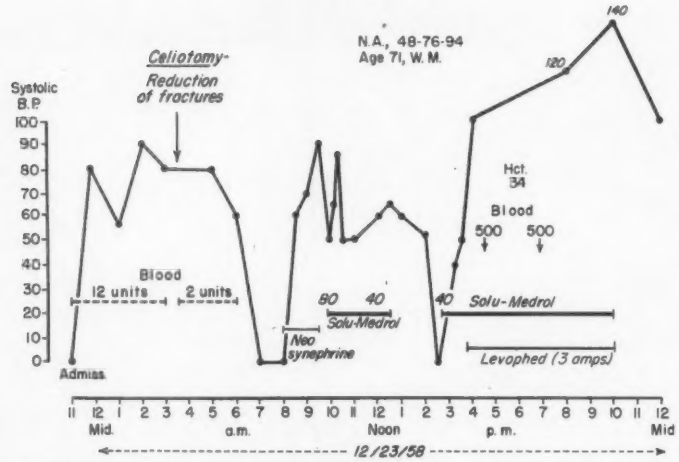

FIG. 2. Management of patient in severe traumatic shock. Systolic blood pressure fluctuations of the accident victim (Figure 1) in severe traumatic shock. Twelve units of blood brought the pressure to 80 mm. Hg. Additional blood and vasopressors were required to maintain the pressure.

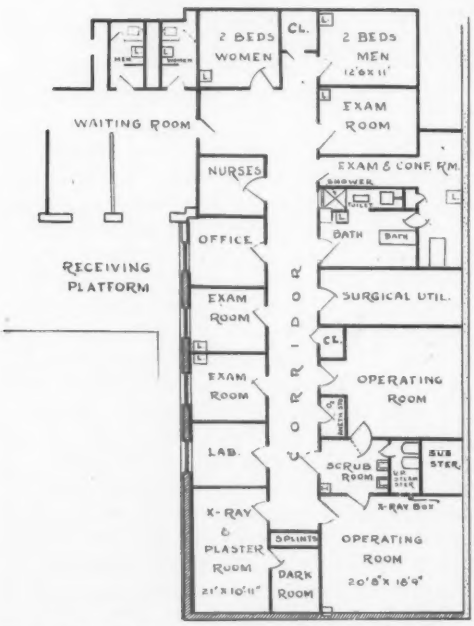

FIG. 3. Floor plan of the Emergency Service at Illinois Research Hospital.

be near the entrance thus avoiding transportation of the injured person on a cart through long corridors. It is not appropriate to recommend any particular number of rooms or arrangements of rooms for the Emergency Service, although certain principles can be recommended. If the hospital is a teaching one associated with a medical school, a minimum number of accident and emergency cases will be solicited to carry on the proper teaching program. The minimum number of visits to the Emergency Room to supply adequate teaching of medical students is probably in the neighborhood of 1,500 per month. Only a portion of these need be accidents, optimally 20 to 30 per cent. For a service utilizing this volume of work certain principles can be advocated for the care of the patients. There should be a window or desk near the entrance at which a clerk or nurse is available to meet the patient. Two or three examining rooms should be located nearby. At least one large operating room, slightly distant from the point of entrance, is necessary. The inclusion of x-ray equipment and a plaster room are optional, but if the hospital has a busy service the presence of these two facilities will be much appreciated by all. Since many patients will have injuries to the head of unknown severity, and perhaps have alcohol on the breath, it is highly desirable to have a couple of beds in two different rooms for overnight observation of such patients. If the hospital conducts a teaching program, a smaller room should be set aside for a conference room to carry on the

teaching. Facilities for bathing, etc., are of course essential. Figure 3 illustrates the floor plan in the Emergency Service in the Illinois Research Hospital. We have found this entirely adequate for 1,500 to 1,800 patient visits per month.

PERSONNEL REQUIRED

The number of people required to conduct an adequate service will vary but a certain minimum skeleton crew is essential.

Physicians. It is desirable, and in fact essential, to have at least two and preferably three interns assigned full time to the service if 1,500 to 1,800 people with emergencies come in each month; with a service this large, the intern should be on duty constantly and remain in the Emergency Room. If the hospital has residents, a resident from each specialty must be assigned to the service day and night, but the resident need not remain in the Emergency Suite; he may be called as needed. If the hospital is associated with a medical school, it is highly desirable to assign students to the Emergency Service. This assignment may be carried out in the evening and week ends for a period of two or three weeks thus eliminating the necessity of full time assignment. In addition to the house officers previously listed, an attending man must be assigned to the Service, particularly at night. Minor injuries and ailments can be taken care of by the intern but he must be instructed to call the respective resident if there is the slightest doubt about the diagnosis or treatment indicated. Likewise if the resident has the slightest doubt about the diagnosis or care, he must call the attending man. Only by this procedure can an efficient service be conducted. It is obvious that a large number of physicians are involved in such a service.

Non-medical Personnel. Nurses are of course a vital part of the Emergency Service. If the service is a large one, the nurse must be on duty at all times. An orderly is essential, but he may be assigned as needed. During the busy periods a clerk or secretary is essential to help keep records and answer the telephone.

PLANNING FOR DISASTER

An Emergency Service is the logical area for receiving a large number of casualties in the event of a conflagration, tornado, etc. Most hospitals recognize the need for a Disaster Plan and we have found it advantageous to use the Emergency Service as the initial receiving point for classifying and routing patients; actual treatment in the Emergency Service would be reserved for patients in severe shock or those requiring immediate resuscitation.

THE NEED FOR ACTIVE SUPERVISION

It is essential that one surgeon be assigned as chief of the Emergency Service. He should not be the head of a department because that person is too busy to carry on effective administration of an Emergency Service. The head of the service must visit the service at numerous times every day and be available for consultation. Supervision of this type is particularly necessary when interns and residents take an active part in the care of patients. The house staff will rotate through the Emergency Service so often that their knowledge of diagnosis and care is always doubtful. In our hospital we have found it essential to conduct a brief indoctrination of the interns before they come on the Service, and we believe it has prevented many serious errors. Also, many young physicians strive for an independent attitude in their care of patients on the assumption that this will develop better initiative and ability on their part. They forget that the sad consequences of errors may be critical indeed. To emphasize this point, we would like to cite the instance of a patient who came to the Emergency Service with a human bite on the hand. The wound was small and appeared very clean. An intern who wanted to be independent and not "bother" his superiors decided he could take care of this patient and sutured the wound. The expected results developed and in about thirty-six hours the patient had evidence of a virulent infection affecting his entire hand; he had to be hospitalized for a few days and treated with intense chemotherapy before the infection could be controlled after the wound was reopened.

If competent supervision is not furnished in the Emergency Service, the house staff physician is apt to make mistakes, and tends to make the same mistakes over and over again. After he has made this mistake a few times, he then considers it the correct procedure for the particular injury or condition. From 150 to 200 patients with lacerations of varying severity require surgical repair in our Emergency Service each month. It is tempting for the busy

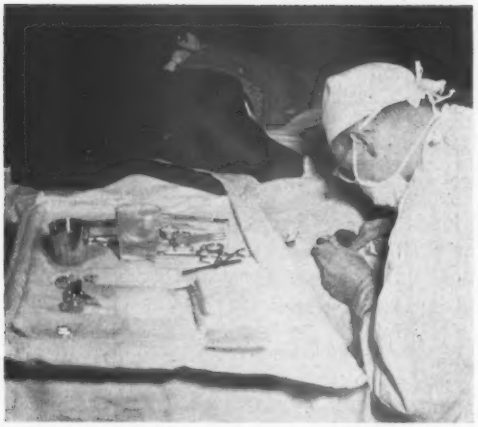

FIG. 4. Rigid aseptic technic is observed for repair of all lacerations, large and small. The intern or resident scrubs, dons sterile gown and gloves and drapes the wound following preparation of the wound. Ordinarily, sterile sheets cover the patient; in this case it was necessary to keep him under constant, close observation.

physician to have the wound rapidly prepared, put on a pair of gloves and hastily put in a few sutures. We insist on full operating room aseptic technic and a meticulous repair for every wound. (Fig. 4.) In this way infections are minimized and time and expense are saved in the long run.

There is an added reason for competent supervision insofar as decisions in the Emergency Service must be made quickly, with meager time for thought and consultation with medical literature. A chronically but seriously ill patient on the ward can be studied at leisure; ample time is available for consultation with superiors and medical books.

THE ADVANTAGES OF PRINTED RULES AND REGULATIONS

Since the intern and resident rotate so rapidly through the average Emergency Service, they will be presented with a vast amount of new thoughts concerning diagnosis and therapy. With a few hours available for reading it is impossible for him to pick out the correct information from large books or voluminous medical literature. We have found it very effective to assemble and print a small brochure of thirty to forty pages summarizing the principles and the treatment of the patients in important accidents and emergency conditions. The house officer is given this brochure before he comes to the Service and is told to memorize it practically verbatim. This he can do, but he cannot remember all the important points in a large book with a few days' study. Even if good supervision is supplied in the Emergency Service, a brochure of this type is advantageous since the supervisor cannot be present every hour of the day, and in fact should not be present all of the time lest this result in failure to develop adequate independence of thought on the part of the house officer. In addition to the brochure containing the important points in the care of the injured patient, or patients having emergency conditions, several books dealing with emergency conditions should be immediately available so that the intern or resident can read between cases. Unfortunately not all of the house officers on duty in the Emergency Service will read books on the subject, but a few of them will, particularly if they are urged to do so.

THE ADVANTAGE OF TEACHING PROGRAMS

Experience has taught us that a teaching program always results in elevation in the standard of care of the patients. Moreover, it stimulates the teacher or attending staff to be confronted with the obligation to teach house officers and students. Actually, patients recognize this advantage, and with few exceptions prefer to go to those hospitals where residents, interns and even students take an active part in the care of the patient. The teaching atmosphere encourages the feeling of confidence in the staff by the patient, and should minimize the incidence of displeasure and legal entanglements.

One of the most difficult, yet important points to achieve in a teaching program is the contact of residents with injuries and emergency conditions in patients to be assigned to other specialties. The resident in general surgery should follow up patients with injured bladders, the urological resident should follow up patients with injuries in the abdominal cavity, etc. Each resident should see the injuries in the other specialties so that he will be able to differentiate injuries in the various organs. The patient does not come in with a tag designating that he has a perforated bladder or perforated stomach; *some physician must make this diagnosis.* A resident cannot be very proficient in the care of injuries in his

TABLE I

PATIENTS SEEN IN THE EMERGENCY SERVICE OF THE ILLINOIS RESEARCH HOSPITAL
(Twelve-Month Period, 1957–1958)

Total number of patients seen in Emergency Service	15,841
Per cent traumatic	18.2
Admissions to hospital from Emergency Service	1,326
Surgery	365 (27.5)*
Medicine	247 (18.6)
Pediatrics	243 (18.3)
Gynecology	164 (12.4)
Orthopedics	153 (11.5)
Obstetrics	75 (5.6)
Neurology	53 (4.0)
Otolaryngology	18 (1.4)
Opthalmology	7 (0.5)
Psychiatry	1 (.07)
Deaths	13
Dead on arrival	20

*Numbers in parentheses are the percentages of admissions to the special services from the Emergency Service.

own specialty unless he has seen injuries of organs in other specialties. This does not mean that he sees these patients with the idea that he will treat them later on in practice. He need know only principles in treatment, but he must know details of diagnosis.

TYPES OF PATIENTS SEEN IN THE AVERAGE EMERGENCY SERVICE

Very few individuals appreciate the great variety of conditions which will appear in the Emergency Service. When one thinks of the emergency room a lacerated arm or gunshot wound quickly comes to mind. However, these represent only a small fraction of the emergency conditions seen in a busy Emergency Service. In a twelve-month period, between July 1, 1957 and July 1, 1958, 15,841 patients were seen in our Emergency Service. However, only 18.2 per cent of their conditions were traumatic. Table I illustrates the great variety of patients seen. It will be noted in the table that 27.5 per cent of the patients admitted to the hospital were admitted to the general surgical service. Unless one is acquainted with the statistics of an emergency room, it will be assumed that the medical department will have comparatively few patients assigned to their wards from the emergency room. However, of the ten departments receiving patients into the hospital from the Emergency Service, the next most common assignment was made to the medical service, namely, 18.6 per cent. It will also be noted in Table I that the orthopedic department which receives all fractures in our hospital admitted only 11.5 per cent of the hospitalized patients coming from the Emergency Service. The types of trauma observed are listed in Table II.

TABLE II

TYPES OF TRAUMA SEEN IN THE EMERGENCY SERVICE

Trauma	No. of Cases	Per cent
Lacerations	1,842	58.9
Fractures	331	10.6
Injuries to the head	646	20.6
Injuries to the chest	161	5.1
Abdominal injuries	57	1.8
Burns	95	3.0
	3,132*	100.0

*Two hundred forty-eight patients (8.6 per cent) had severe multiple injuries.

Accordingly, an Emergency Service involves every specialty in the hospital, and every specialty must take part in preparation of the teaching program.

What Is the Profit in Driver Education?

HAROLD W. WOUGHTER, M.D., *Flint, Michigan*

WITHIN one generation the promotion of traffic safety has become a business. Years ago the man who bought an automobile was considered something of an eccentric and certainly none of his bemused neighbors was very seriously concerned with how he behaved behind the wheel.

Today the adult who does *not* drive is more apt to be considered eccentric, and nearly everyone is seriously concerned about how we can prevent forty million drivers in this country from killing and maiming each other at an ever-increasing rate.

The promotion of traffic safety has evolved into a concerted national effort on which hundreds of thousands of dollars are spent a year. It has assumed the same national scope as the crusades against cancer, poliomyelitis, tuberculosis and muscular dystrophies. Established agencies have been compelled to contribute to the effort—industry, the professions, legislative and judicial bodies, school systems, police departments and others. The administration of the business of traffic safety has actually created new jobs within our economic structure, and these are jobs which have a disturbing way of demanding results.

The profit in this business is measured in lives saved. Great investments are made annually in time and money by the various agencies and organizations. The greatest of care must be exercised to achieve a balanced effort, in order that an adequate profit in lives saved will justify continuing effort on the part of each contributor.

FACTORS FIRST BLAMED FOR TRAFFIC TROUBLE

At the beginning of the movement to increase traffic safety, there was a tendency to point many accusing fingers in many directions. The first villain accused was the alleged instrument of destruction itself, the automobile. A little later some of the more sophisticated critics began to criticize civil engineers for lack of imagination in road design and construction. Through the years people singled out such scapegoats as ill-conceived laws, slack law enforcement and antiquated statutes.

Ultimately, the persistence of these attacks has produced beneficial results. Automobiles have become safer. Roads are now built to protect the driver even against himself. Traffic control systems and law enforcement methods no longer serve as "traps" but are designed for greater safety for all. With professional help, better methods have been devised for the transportation and care of the injured.

Although great strides and improvements were made in all these fields, slowly and ever so surely came the recognition that something needed to be done about the driver himself. Somehow someone had to do something about changing the design of the person behind the wheel, and this was not an engineering problem. The first fruits of this realization were plans that published the highway deaths for a given year or holiday weekend, the total injuries for a period of time, the loss in dollars caused by highway carelessness or other carefully compiled statistics, all of which were interesting to the average person but frightening only to the most sensitive, deepest kind of thinker. On the whole, figures and statistics come woefully short of shocking the average motorist into realizing his own risks or responsibilities. It is always the other fellow who needs to be carefully taught.

THE ROLE OF THE PHYSICIAN

The pathetic and too little publicized result of careless driving is the injured and incapacitated victim of an accident. Over 150,000 traffic injuries yearly result in some degree of permanent disability, and these disabilities are not always the obvious physical cripplings

that cause invalidism. Sometimes they take the form of mental instability caused by unsightly scarring and sometimes they become subtle guilt complexes associated with actions taken that led to stark tragedy. Often the burden is economic too. Many a life's savings has been drained to make financial amends for a moment's carelessness. Families have been broken up with children becoming the burdens of relatives. Victims have entered nursing homes or have become charges of state-supported institutions and hospitals, all requiring elaborate facilities and services. All these pathetic results become a daily problem for the physician and surgeon along with his specialty consultants.

The study of the injury and its method of production, automobile design and injury patterns, and accident frequency as it relates to diseases and the use of drugs are as much the concern of the responsible surgeon as the lay investigator. Articles on these subjects should increase in quantity and quality.

WHAT ABOUT DRIVER EDUCATION?

The greatest weapon for good in a democracy is education. The greatest weapon in the campaign for safety on the highway is an informed driving public. The public so desperately needing to be educated in safe driving habits falls roughly into three groups: (1) the great mass of the driving public—some good, some bad, some with merely bad attitudes and some grossly unfit for medical reasons to drive at all, (2) teenagers who are qualifying for licenses for the first time and (3) the geriatric group in whom hazards increase with age and who present special problems of their own.

What can be done in the way of education with the great mass of the driving public is somewhat limited, for they are a group extremely difficult to reach except through the mass media.

Physicians, however, are in a position of exercising some influence in at least one area, that of the medical aspects of driver licensure. Physicians need to take more seriously the factors concerned in the granting of a license to drive.

Because a physician deals in services, and the patient is his only as long as he renders a satisfactory physician-patient relationship, he is often reluctant to face up to the problem of physical disabilities as they effect driver licensing. The legal profession finds that people are stoic and even remorseful when facing the court on charges of causing bodily injury or death, but if the threat of removal of their license to drive is expressed, immediately they become angry and even volatile. They will vigorously carry an adverse decision through all appeal courts, yet the doctor is reluctant to advise agencies to revoke even temporarily his patient's license to drive.

This attitude may be only the reflection of facts as they are. In only four states in the Union is there a requirement that physicians make available to driver-licensing bureaus reports of such significant diseases as diabetes and epilepsy. Of forty-two states having Governor's Traffic Safety committees, only twenty-three have representation of the medical profession. In thirty-eight states there are no established channels of communication with which to inform motor vehicle administrators or driver training schools whether or not applicants for driving permits have any record of mental illness. It should become increasingly evident to both the driver and the physician that the license to drive a motor vehicle cannot be an inalienable right but must be a privilege that carries with it the grave responsibilities concomitant with such a privilege.

DRIVER EDUCATION FOR TEENAGERS

Probably the best long-range plan for improving the over-all quality of drivers is good driver education training for teenagers, both in the classroom and behind the wheel. The more than 20,000 high schools in the United States have in them a tremendous captive audience of teenagers, 1.6 million of whom become eligible to drive an automobile each year. Regrettably, only about three of ten get training both in the classroom and in actual car operation. The cost of good driver-training programs, particularly when measured in terms of pupil-teacher ratios, is enormous. By its very nature, it is really private tutoring. The cost must be shared by community business organizations and volunteer labor.

A UNIT SURVEY

The driver education program of the Flint public schools began in 1954. Since that time more than 7,000 students have been instructed in the skills and attitudes of safe driving. (Fig. 1.) To make such a program click in-

FIG. 1. The Flint driver training range has been described by national authorities as the best equipped in the nation. Over 7,000 students since 1955 have received training here. The building at left contains classrooms, garages and special training devices.

volves a great many community businesses and organizations. The Flint Automobile Dealers Association has furnished nineteen automobiles through an auto assistance plan. The General Motors Corporation encourages such civic support by its dealers through a plan that awards $125 to any dealer for each automobile loaned to the program. This is, in fact, a national policy. General Motors dealers alone provided 5,182 new cars to high schools around the country during the year 1957–1958. Ford, Chrysler, Studebaker-Packard and others have done proportionately the same.

In Flint, the liability insurance for the program is furnished by the Association of Fire and Casualty Underwriters, who believe they have scored heavily in keeping insurance rates low through this means of encouraging better driving among their insured.

The Genesee County Traffic Safety Commission gives invaluable aid to the Flint program with organizational know-how, instruction and timely assistance in all aspects of the program.

The list of community agencies and organizations now participating in the program is exhaustive. Among them are: The Flint Automobile Club, The Manufacturers' Association, The Parent-Teachers' Association, The Police Department, The Recreation and Park Board, The Michigan Inter-Industry Highway Safety Committee, The Mott Foundation Program and The Genesee County Medical Society.

The contributions toward this program by the medical society are varied, but one unique experiment conducted may be of particular interest.

In the spring of 1958 each high school in Flint held an assembly of all students who had completed the course in driver education. A doctor representing the local medical society and the Trauma Committee of the American College of Surgeons presented an illustrated talk on the medical aspects of traffic safety. The presentation emphasized the consequences of driving while under the influence of drugs and alcohol. It also dealt with accidents caused by drivers with incapacitating diseases producing temporary crises, such as epilepsy and diabetes.

Graphic illustrations of accidents caused by carelessness, poor attitudes and violations of the law were presented. The color slides of these actual cases were sometimes too realistic for the young audience to withstand comfortably.

A questionnaire answered by the students after the presentations measured their reactions. In all, there were four assemblies. In three assemblies injury to the body from

accidents was dramatically emphasized with the realistic slides. In the fourth, the stress was placed on the effects of alcohol, drugs and debilitating diseases. The results are contained in Table 1. It is interesting to note that the bodily injury approach apparently frightened quite a few students, while the "drug and disease" approach gained quite a different response to the question, "Did the talk create fear or upset you?"

TABLE 1
STUDENTS' REACTIONS TO TWO KINDS OF PRESENTATIONS ON INJURY FROM ACCIDENTS

	Bodily Injury Approach		Drug and Disease Approach	
	Yes	No	Yes	No
1. Did the doctor's talk have meaning to you?	222	6	109	2
2. Did the talk create fear or upset you?	148	81	2	110
3. Do you believe the talk was informative and that all students should have the opportunity to hear it?	213	7	107	4
4. Do you believe the talk contributed helpful information to the driver education program?	164	14	106	1
5. Do you think students should have an opportunity to see actual automobile injury cases?	169	51	95	14

THE ROLE OF THE COURT

In spite of all efforts to the contrary, there are those students who repeatedly violate traffic laws and frequent the Municipal Court. In August 1958 a sort of "postgraduate" or refresher course was inaugurated for these apparent incorrigibles. Twenty-four young adults reported at the request of the court to a series of four two-hour courses designed to teach them better driving habits. This was the first time, in Flint at least, that this type of education was made a part of a court procedure to curb bad driving habits. Of the twenty-four students enrolled, seventeen completed the course satisfactorily and the majority were attentive and interested during the duration of the course.

THE GERIATRIC GROUP

Serious thought has been given in Flint to encouraging people over the age of sixty-five to take driver training. Older people are sometimes reluctant to part with an old car for fear of not being able to react properly to the new and automatic devices on later models. With this thought in mind, the Mott Foundation Adult Education Program of the Board of Education took pains to make enrollment in driver-training courses for older people especially easy and attractive. The response was most encouraging; they took to behind-the-wheel training with vigor. They also received well the classroom suggestions that they drive during the slack hours of the business day, avoid unnecessary trips during bad weather and plan most of their trips during the day.

In one year, September 1956 to September 1957, there were ninety-one students over forty years of age attending part or all of the driver-training program.

That this type of training is a significant thing for conscientious communities to consider is reflected in some figures on the fatal accidents that occurred in Flint during the calendar year 1957. Of sixteen traffic deaths in 1957, ten of the people killed were over the age of forty and six were over the age of sixty-five. During the same year, 3,548 drivers were involved in accidents, and of these 105 were sixty-five years of age or older. These figures would seem to indicate that perhaps the public is too conscious of driving frailties among our youth and not nearly enough aware of the safety shortcomings of our older population.

A REHABILITATION PROGRAM

Another unique public service offered by the Flint Driver Education Program includes trials in reaction time, attitudes and abilities offered near the end of rehabilitation following disabling accidents. This offers trial runs in cases in which some form of permanent disability exists. In other cases it simply offers the bolstering of confidence after unpleasant experiences.

RESULTS

Does such a program as Flint's, involving considerable cost and recruiting the services of so many agencies, pay off in lives saved? Records kept by the local Traffic Safety Com-

mission show that during 1958, 95.5 per cent of those people who had completed the Driver Education Program in Flint had a record of absolutely no violations. In addition, not one graduate of the courses had been involved in a serious traffic accident.

On January 1, 1959, the National Safety Council ranked Flint as second in the Nation in traffic safety among cities with a population of 200,000 to 350,000. There were 1.1 deaths per 10,000 registered motor vehicles.

During 1958 the city had a no-fatality record for six of the twelve months. Contrast this with the record just four years ago, 1955, when Flint held last place in traffic safety among cities its size. The odds for survival have certainly improved.

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Taking the Trauma Out of Traffic

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THE promotion of highway traffic safety is an important objective of the automobile industry. We believe that good "industrial citizenship" imposes a responsibility on us to participate substantially in this vital work. We also have a strong commercial motivation to do so, because our market is measured by the pleasure and utility of travel by car.

Our effort to make a constructive contribution is guided by several basic convictions about traffic safety. The first is that a severe toll of traffic accidents need not be accepted as an inevitable by-product of the automotive age. Accidents have causes which can be controlled. They are inevitable only if our attitude is fatalistic or our approach is fallacious. This is demonstrated by the fact that, bad as the problem continues to be, some progress is being made.

Contrary to a widespread impression, traffic deaths have not been mounting steadily. The highest toll on record, 39,969 deaths, occurred in 1941. That was 3,000 more than occurred in 1958. Moreover, in each of the past two years there has been an encouraging reduction.

The most impressive measure of progress has been the steady decline in the death rate per 100 million vehicle miles. In 1958, this rate reached an all time low of 5.6, less than half the rate in 1941. This statistical progress is not grounds for complacency as long as the actual toll of death and injury continues at such a high level. However, it does indicate that constructive forces are at work.

Our second conviction is that the solution lies only in a broad, balanced program of engineering, enforcement and education, not in any panacea. Those who persist in seeking some nostrum ignore the fact that this problem involves a host of causative factors, calling for a many pronged approach to the objective of ever safer roads, cars and drivers. To concentrate exclusively on one or a few elements is worse than futile—it retards more widespread application of really effective programs.

An important corollary to this need for a broad attack is the fact that we must undertake more research to extend our knowledge of the causes of accidents and of the efficacy of various preventive measures. Many doctrines of traffic safety are unduly predicated upon unsupported opinions.

Thirdly, we recognize that substantial results will be achieved only by a sustained effort of adequate intensity. Sporadic, half hearted measures will not work. Moreover, in many respects the problem calls for continuing control rather than "one-shot" solutions.

Next, we have the firm conviction that this problem should be dealt with chiefly by state and community action. Although the federal government can and should participate, through such actions as the federal-aid highway program, sponsorship of research projects and promotion of nation wide coordination, there is no need for, nor advantage in, a program largely directed from Washington. The "national problem" is essentially the sum of many local ones produced by our predominantly local traffic. It is far more efficient and effective, and more consistent with our form of government, to develop state and community programs soundly adapted to local conditions.

This conviction is strongly supported in the recent report of a study on highway safety made by the Secretary of Commerce at the direction of Congress. The report states: "The direct projection of federal authority into highway safety functions that have been the responsibility of state and local governments is concluded to be impractical, and would only weaken state and local authority."

We also have the conviction that prevention of traffic accidents is primarily a job for

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responsible public officials, not "vigilante" groups or amateur experts. The only "do-it-yourself" responsibilities of the individual citizen are to be a careful driver and pedestrian and to support sound official action.

Finally, it is our firm conviction that the greatest attention must be directed to "driver improvement." Leading authorities on traffic safety have repeatedly stressed that of the three elements in accidents, the road, the car and the driver, the most critical is the driver. It is his physical or mental deficiencies, his lack of knowledge and skill and his improper attitudes, to which most accidents are directly chargeable.

Guided by these convictions as to the kind of action that is needed, the automobile industry carries on a broad and intensive program of traffic safety. One phase of this program concerns our own direct and critically important responsibility to make automobiles as inherently safe as is practicable. This work has two specific objectives: To facilitate safe driving and to decrease crash injuries.

The other phase of our work in traffic safety is represented by a great variety of activities to encourage better driving, modernization of highways and improved measures of traffic control.

Promotion of traffic safety by improvements in vehicular design is not a new concept. This has always been a major concern of the industry. The only thing that is new, and it is a dangerous fallacy, is the belief of some persons that more fool-proof and crash-proof cars are the major answer to the problem.

The industry can facilitate safe driving, but it cannot compel it. It can provide a measure of protection against crash injury, but it cannot repeal the laws of nature.

There must, therefore, be more realistic and less wishful thinking on this score. Still further advances in vehicular safety are to be desired and are certain to come, but overemphasis on the potential value of this approach, to the neglect of urgently needed improvement in driver performance, will only retard progress.

The industry's strong preoccupation with the inherent safety of cars is evidenced by the steady parade of new and improved safety features over the years.

Safe driving has been facilitated by such basic advances as vastly improved brakes, lights, steering, tires, suspension and field of vision, and by such devices as automatic windshield wipers, washers and defrosters, direction signals, headlight beam indicators and foot switches, speed warning indicators, power brakes, power steering and many others.

Protection of occupants from crash injury has also been greatly increased over the years. Two of the greatest contributions ever made to this objective were the adoption many years ago of safety glass and all steel bodies. More recently such further aids as padded panels, recessed steering wheels and control knobs, interlocking door locks and seat belts have been introduced.

Improved performance of engines has also contributed to traffic safety by providing the better acceleration at normal speeds which reduces the hazards of collision in certain maneuvers. Contrary to a widespread impression, neither the objective nor the result of increased horsepower has been a substantial increase in top speed. Moreover, official studies indicate that average highway speeds have not risen appreciably in recent years and that most accidents involve speeds which, although often excessive for existing conditions, are in the medium range.

Progress in vehicular safety, as in other phases of automotive development, has been importantly stimulated by the strong competitive force that pervades this industry. At the same time, there has been considerable industry-wide cooperative action when this approach best serves the public interest. Such action is exemplified by the technical liaison of industry with the American Association of Motor Vehicle Administrators, the joint support of the Cornell University Medical School's crash injury research program, the vehicle safety projects of the Society of Automotive Engineers and many others.

The greatest hope for further advances lies in continuing primary reliance on this voluntary industrial program. The automobile manufacturers' demonstrated desire and ability to produce ever safer vehicles indicates that there is no need to inject a substantial further degree of governmental regulation in this field. In fact, such a step might well impede progress.

The often slow process of modifying regulations tends to "freeze" compulsory design specifications, thereby retarding adoption of improvements continually being developed by industry. Moreover, vehicular safety is so

intimately related to other elements of automotive design and performance that any attempt to subject this one feature to isolated and independent control could result in a highly impractical approach.

The automobile industry's activities in traffic safety in areas other than vehicular design cover a wide range of projects, sponsored both cooperatively and by individual companies.

The leading example of industry-wide action is the substantial financial support, since 1937, of the Automotive Safety Foundation. This agency's program of grants and staff services has been one of the most productive forces in the field of traffic safety.

Industry groups have also worked closely for many years with public officials and leading organizations devoted to traffic safety on many productive studies in areas ranging from uniform traffic laws to highway design. Typical examples of the independent activities of automobile companies include the production and broad distribution of films and booklets on safe driving, extensive use of advertising media for promotion of traffic safety, cooperation with dealers in the loan of training cars for high school driving classes and contributions to community safety organizations.

The automobile industry's extensive efforts to promote traffic safety by working for improvement in the vehicle itself, in the manner of its operation and in the environment in which it is used, are impressive evidence of our constructive interest in this vital objective. Because so much still remains to be done, particularly in reducing human errors on the highway, or minimizing their harmful results, this industry will certainly continue its efforts.

Forecasting is difficult in such a dynamic and rapidly evolving field as automotive transportation, but some things about the future are fairly clear. We can certainly anticipate a steadily rising volume of traffic with growth in population, economic expansion and increasing dependency on automotive transportation.

This prospect emphasizes the need for still better traffic safety programs. However, it does not mean that we must submit to a still higher toll of traffic accidents. Not only the ratio of casualties to miles traveled, but also the actual number of deaths and injuries, can be sharply reduced if we make an adequate, soundly directed effort.

One of our chief causes for optimism is the vast program of highway modernization now under way. This will do much to make driving safer as well as more attractive in other respects. However, we must not expect too much of modern design roads. Although vastly safer, they will not be fool-proof.

As to the automobile of the future, we can certainly anticipate substantial further progress in design features and equipment intimately related to traffic safety. One aspect of such progress will be further improvements in such important basic safety features as lighting and stability. More advances in the reduction of crash injuries are also probable as we learn more about how passengers are injured and what protective materials and designs are most effective and practical.

Further simplication of driver control is one of the most intriguing prospects about the car of the future. With manual operations already greatly reduced, automotive engineers are intensively pursuing their search for more aids to enable motorists to concentrate more on road and traffic conditions, to reduce fatigue and to lessen human error.

Long range research has already produced such experimental devices as an automatic car guidance system and a single unit control lever for steering, accelerating and braking. Such innovations are not ready for introduction, nor are they necessarily indicative of the precise form that new control devices may some day take. However, they are indicative of the constant search for better methods and are helpful in exploring new concepts of electronic control.

Fascinating and promising as this exploratory work is, a realistic look ahead leads to one inescapable and dominant conclusion: a substantial increase in traffic safety within the foreseeable future will be achieved only if we place major emphasis on improvement of *driver performance*.

This calls for more and better action on three fronts. First, we must do more research to learn the influence of various physical, mental and emotional factors on driver skills and attitudes.

The previously quoted report on highway safety submitted to Congress by the Secretary of Commerce states, "The importance of human factors in traffic accidents is of course generally accepted . . . The full effect of hu-

man factors is so complex as to require intensive investigation of traffic accidents by a team of scientists from at least the fields of medicine, psychology and engineering. Preliminary results of an intensive study of this type . . . disclose a tremendous difficulty in even measuring pertinent dimensions of the human problem. . . ."

Excessive reliance on an empirical approach has resulted in much misdirected effort. Only recently have objective studies begun to indicate the extent of fallacious thinking about "problem drivers."

Statistical analysis, for example, has finally dispelled the myth that most crashes are caused by a small group of "accident-prone" drivers. Also, psychiatric studies have disproved the equally false concept that people guilty of antisocial behavior behind the wheel are usually models of courtesy in other situations.

Secondly, we need greatly improved programs of driver education to develop both the skill and the will to drive properly. The rapid growth of driver training in the high schools in recent years has been a highly encouraging trend. However, much remains to be accomplished in this field.

Equally pressing is the need for improvement in the educational and persuasive valùes of propaganda about traffic safety aimed at the general public.

It has become quite clear that most people cannot be scared into becoming better drivers. Likewise, vague general appeals to "be careful" have little effect. Moreover, propaganda about safety must somehow overcome the barrier of the average person's belief that his driving is above reproach.

Finally, achievement of a nation of consistently good drivers awaits far more widespread application of sound measures in the fields of licensing of drivers and enforcement of traffic laws.

Development of better programs for the control and improvement of drivers is, of course, the primary responsibility of legislators and traffic safety officials. However, the authorities cannot hope to make substantial progress without active public support and the technical counsel of many professional groups.

The medical profession, for example, can make many significant contributions. The respected voice of medical men carries strong weight when they actively endorse sound legislation, policies and procedures concerning traffic safety. Participation of the medical profession is vital to the effective conduct of research programs concerned with physiological factors bearing on the performance of drivers. The profession can obviously also be of great help to the automotive industry in its efforts to reduce the potentials of crash injury.

In short, our greatest needs are for more individuals to practice "defensive driving" whenever they take the wheel and for more groups to "join the offensive" against the causes of traffic accidents as a part of their professional and civic responsibilities.

Because this is a complex problem, it calls for thorough, patient efforts in many technical areas. It is largely a job for experts. At the same time, we must not let our preoccupation with technical matters obscure the fact that in an important sense traffic accidents do not constitute a unique, isolated problem. They are, rather, in a large measure a symptom of such basic human weaknesses as ignorance, immaturity, irresponsibility and selfishness. These unfortunately have more devastating consequences on the highway than in most other environments, but the automobile is merely a conspicuous medium for the display of antisocial behavior, not the underlying cause of it. Whatever action we take against the basic causes will produce safer traffic among other gains and thereby enable us to enjoy even more fully the social and economic benefits afforded by the automobile.

This does not, however, warrant the pessimistic view that we must await a utopian society to take the trauma out of traffic. The history of social progress has been largely one of gains in specific areas that ultimately have a broad beneficial impact.

It may well be that effective promotion of better conduct on the highway will be quite helpful in encouraging the mature, responsible behavior in all human relations that is essential to a better society. This possibility makes it all the more compelling that we move aggressively to eliminate obstacles to maximum highway safety.

Our Traumatized Society

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AMERICA is on the move, more than ever. About eighty million licensed drivers drive 650 billion miles a year. There are seven and a half million boats, as compared to two and a half million in 1947, and about half of the buyers now also buy a trailer to augment their mobility. Last year a million nimrods joined the twenty million in the hunting fraternity, and almost a million fishing licenses were added to the twenty million on the books. The ranks of the three million skiiers are swelling by an impressive 200,000 a year. We are a nation of 175 million people living as fifty million households; more than ten million families move during a year, and there are more than a million mobile homes. All this movement provides chances for accidents, and the prevention of accidents.

MORTALITY

The optimist can point to the 5 per cent decrease in accidental fatalities during this past year. (Table 1.) The death rate in 1958 per 100,000 population was 52.5, the lowest rate on record [1]. The next lowest rates are 55.9 for 1954 and 56.0 for 1957. Accidents can be prevented, and accident victims can be saved by improvements in surgical and medical treatment: witness the 30 per cent drop in the death rate for all accidents during the thirty years since 1928, with a stunning 51 per cent reduction in the death rate for work accidents [2].

The realist—and he can be an optimist, too—is aware that about 91,000 people were killed in accidents in 1958 (Fig. 1), about 340,000 were

TABLE 1
THE NATIONAL ACCIDENT FATALITY TOLL

Location of Accident	1958	1957	Change
Motor vehicle	37,000	38,702	−4%
Public place (non-motor vehicle)	16,500	17,500	−6%
Home	27,000	28,000	−4%
Work	13,300	14,200	−6%
Total of all accidents	91,000	95,307	−5%

NOTE: The motor vehicle totals include some deaths also included in the work and home totals. This duplication amounted to about 3,200 in 1957 and 2,800 in 1958. The 1957 all-accident and motor vehicle death totals are the official figures of the National Office of Vital Statistics. All others are National Safety Council estimates.

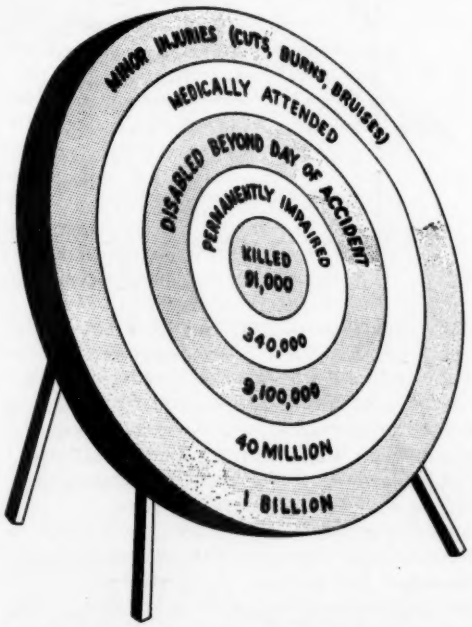

FIG. 1. Target for safety. "Medically attended" includes persons whose injuries caused them to restrict their usual activities for at least a day (including the day of accident) as well as those who had injuries that were medically attended.

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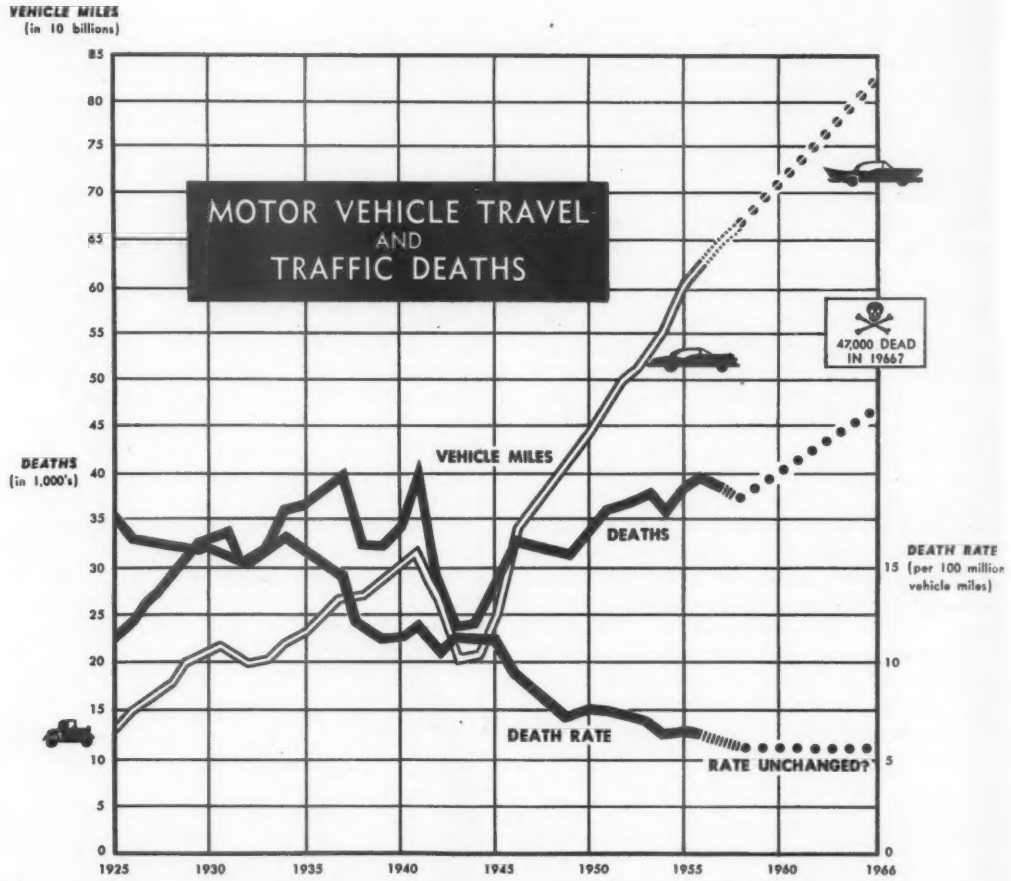

FIG. 2. Motor vehicle travel and traffic deaths as charted by the National Safety Council.

permanently impaired (ranging from partial loss of use of a finger to blindness or complete crippling), about 9,100,000 were disabled beyond the day of accident, and forty million more people were injured severely enough to restrict their activity or require medical attention [3]. This grisly aspect of our traumatized society is well known to the surgeon.

All this makes accidents the No. 1 cause of death in the age groups from one through thirty-six. For all ages, accidents rank as follows: first by working years lost [4], second only to heart disease by life years lost, and fourth by number of deaths.

PLACE OF ACCIDENT

Motor Vehicle. The vehicle mileage total rose in 1958 (Fig. 2), but the deaths from motor vehicle accidents went down. Three-fourths (27,300 deaths) were from accidents in rural areas and towns under 2,500 population. In the largest cities (with the exception of Los Angeles) most of those killed were pedestrians.

Public Places. Drownings and falls accounted for about half of the fatal accidents in public places, other than occupational and motor vehicle. The explosive increase in the number of motor boats and in outdoor recreation generally is balanced by increased attention to the safe enjoyment of these recreational activities. More than two-thirds of the fatal accidents in public places happened to people less than sixty-five years of age. In addition to the 16,500 killed, it is estimated that about 50,000 were permanently impaired and two million disabled beyond the day of accident.

Home. Falls were involved in nearly half of the 27,000 deaths from home accidents. There were about four million disabling injuries. These home injuries cost an estimated 900 million dollars in 1958, including wage loss, medical expense and costs of insurance. Half of those persons killed were sixty-five years old or older.

Work. The 1958 death total for work accidents was approximately 13,300, and there were 1,800,000 more persons disabled beyond the day of accident. The cost was almost four billion dollars, including such indirect costs as damaged machinery and material, and interrupted production schedules.

Off-the-job safety has become an integral part of industrial safety programs because so many workers are hurt in traffic, public and home accidents. In addition to the 13,300 workers killed while at work, 29,200 died from off-the-job accidents; the total of 42,500 workers [5] killed accidentally is nearly 47 per cent of all fatalities due to accidents, and constitutes an appalling toll of working and living years lost.

In all three branches of the Armed Forces, accidents are now the leading cause of man-days lost, exceeding even infections of the upper respiratory tract. Most of the 2,100 servicemen killed in motor vehicles each year are off-duty and in privately owned vehicles at the time of the accidents. Whayne [6] writes that, "During World War II, almost 33,000 deaths overseas were caused by nonbattle injuries. More realistically, nonbattle trauma was the cause of one in every five notifications of death sent to the family of a United States soldier."

CAUSE AND EFFECT

Saftey and trauma are two ends of the same piece of rope. The complete story of an accidental injury includes the complex interactions between man and his environment: it starts with background factors, goes on to a change, possible reactions to the change, the moment of the accident, then injury, first aid, transportation of the injured, treatment, rehabilitation. Perhaps even then the story drags on with physical and emotional and financial complications.

Ten years ago Fansler charted the dynamics of a traffic accident [7] to visualize the sequence of events which begins with movement in the interactions of people and their environment, includes safe or varying degrees of unsafe adjustments to the human and environmental changes involved, and concludes with continued movement or a "near miss" or accidental injury or damage.

Some beginners look for one single device or act which would prevent most accidents, but those with long experience in accident prevention have learned that safety is a way of life, e.g., "we drive as we live." Therefore, attention is directed to many important parts of the accident syndrome, and a number of the elements of the comprehensive safety program are of interest to surgeons.

The health of the people concerned is a logical beginning. Bissell [8] asks: "Did the elderly man have a stroke and fall, or did he fall first, causing an injury to his head? Did the persons with osteoporosis fall because of the thinning bone or because of the slick floor? Did the elderly man with a fractured hip who died of pneumonia four months after the injury die of a respiratory disease or from an accident? What was the intent of the person who took an overdose of medicine—was it accidental or suicidal?"

Realizing that a certain undetermined percentage of accidents is caused directly or indirectly by medical conditions, such as drugs and other related physical factors, the American Medical Association established a committee to study the medical aspects of automobile crash injuries and deaths. The chairman, Dr. Fletcher Woodard [9], reports that his committee is now preparing a book to advise the physician relative to his patients' driving limitations that may be involved in physiologic states, pathologic conditions, emotional disturbances, and drugs and alcohol.

Behavioral scientists are making their contributions to an understanding of accident causation. For example, Malfetti [10] sees signs of the same sociopsychological influences operating in the behavior of both drivers and pedestrians: "Risk-taking behavior is rewarded each time a person successfully crosses against the light; perception of the pedestrian is interfered with by an emotional state; the pedestrian is unconvinced that *be* will be killed or injured, and many of the risks he takes probably are attempts to prove his masculinity."

Finding the kind of individual or family most likely to have accidents is somewhat like finding the kind of individual or family most likely to have the common cold. McFarland [11] reports that "no single characteristic of drivers is out-

standing in accounting for a large proportion of accidents on the highway." Thus safety is not for other people, the "accident prone"; safety is for me and you.

McFarland has supervised exhaustive research and written prolifically on the biological and psychological characteristics of the driver which should influence mechanical design. He writes [*12*]: "In general, any control lever that is unnecessarily difficult to reach and operate, any instrument that is difficult to read, any seat that induces poor posture or discomfort, or any unnecessary obstruction to vision may contribute directly to an accident. In addition, the cumulative effects of such difficulties lead to fatigue, to the deterioration of driver efficiency, and perhaps, eventually, to an accident."

Changing the environment is a more tangible and measurable activity than helping people to change themselves. The hazards to be minimized are not only those which play a part in the causes of accidents but also those which cause trauma. Engineering for safety, including personal protective equipment, plays a major role in industrial safety, and this emphasis is now increasing in other areas of safety. Braunstein, Moore and Wade [*13*] have reported that their "preliminary findings on evaluation of the efficacy of recent 'safety design' in 200 1956 cars involved in accidents seem to indicate about a one-third decrease in the incidence of doors opening on crash impact with no rollover (representing approximately 80 per cent of the accident configurations). A decrease of 49 per cent has been observed in occupant ejection. The decrease of 29 per cent in dangerous to fatal grade injuries is most probably the result of the lessened risk of ejection."

Seat belts are especially promising as personal protective equipment against injury to motorists involved in traffic accidents. Moore [*14*] reports a "60 per cent reduction in the risk of injury observed among the seat belt users."

The saftey movement strongly supports the use of personal protective equipment, e.g., hard hats, safety glasses, safety belts and safety shoes. At the same time, those concerned with safety do not settle for just treating the symptom; the basic objective is to prevent accidents. Blossom [*15*] spoke for many of those working in safety when he said, "The most effective method of treatment of the problem of automobile deaths and injuries is attacking the basic causes, thereby effecting a reduction in the number of accidents."

Special campaigns are conducted on single elements of the comprehensive safety program. It is always difficult to try to make an impact on tens of millions of people on a specific subject, and at the same time to keep all concerned reminded that the specific subject is only one part of a balanced program. For example, speed control is only part of a comprehensive safety program; Moore [*16*] rightly points out that "there seems to be a definite limit to the amount of improvement that can be achieved by absolute speed regulation."

UNITED ACTION

Our traumatized society needs comprehensive solutions to problems as extensive as accident prevention and the care of the accidentally injured. Dr. John D. Porterfield, Deputy Surgeon General of the Public Health Service, puts it this way [*17*]: "The problems that confront us today are not one-agency problems . . . To achieve our ends in these fields will require a harmonious coordination of planning and effort, of institutions and agencies, of citizen groups and professional organizations, of concepts and methods. If this sounds formidable, it can't be helped. It's a formidable problem." Chapman [*18*] points out that an all-out attack on accidents "can only be accomplished by attacking the problem simultaneously on many fronts."

Therefore, a wide variety of organizations—governmental, industrial and voluntary—work jointly as well as separately. Business groups founded the National Safety Council in 1913, and the Congress of the United States chartered the Council in 1953, in part "to cooperate with, enlist, and develop the cooperation of and between all persons, corporations, and other organizations and agencies, both public and private" [*19*] in a nationwide safety movement. "The major function of the council," testified General Manager W. G. Johnson [*20*], "is to serve as a meeting place for all organizations concerned with the prevention of accidents."

Representatives of these governmental, industrial and voluntary organizations have grouped themselves into twelve special-interest conferences or committees of the National Safety Council: Farm Conference, Home Conference, Industrial Conference, Labor Con-

ference, Motor Transportation Conference, Public Information Conference, Religious Committee, School and College Conference, State and Local Safety Organizations Conference, Traffic Conference, Women's Conference and Youth Committee.

A formal statement of policy by the governing body, the Board of Directors [*21*], specifies that "The Council's organizational, financial and membership structure is purposely broad and flexible so that it will provide continuity of operation and always serve as a place for group planning and execution by all who take part in the Safety Movement." Meetings, correspondence, field work, and a dozen magazines and three dozen newsletters provide opportunities for this "group planning and execution." More than 10,000 delegates participate in the annual National Safety Congress in Chicago in October.

Each discipline brings its own competency to safety and discusses the subject in terms of its own vocabulary. The engineer emphasizes that we must engineer the hazard out of the job, the military man fights a war against accidents, the public health physician writes of the epidemiological approach to accident prevention, the educator sees safety as an educational job requiring participation and community organization, and the policemen speaks of preventing accidents by selective enforcement.

THE ROLE OF THE SURGEON IN SAFETY

The competencies and part of the vocabulary of the practicing physician and surgeon are equally apt when applied to safety. The multiple etiology discussed by Dubos [*22*] is as applicable to accidents as it is to many human diseases. He says, "In practically all infections and metabolic disorders, physiological and environmental factors can readily be shown to be important determinants of the disease process." This plea to look beyond the germ has its counterpart in the current plea in the safety movement to look beyond the environment and give more consideration to the human factors. Dubos writes that "The factor which disturbs the equilibrium may affect only one or a few individuals and give rise to isolated cases of clinical disease, or it may affect simultaneously many members of the community and cause crowd diseases." Note how applicable this is to accidents: a factor in poisoning may affect an individual or a crowd.

Dubos describes the practice of medicine and surgery as "an art based on wisdom and skill derived from experience as much as on scientific knowledge and reasoning." The practitioners of this art are certainly needed in the safety movement which is concerned with so many independent variables in accident situations. Many surgeons see accident victims every working day and are the first to know of new kinds of accidental injuries, some safety people rarely see accident victims.

Reporting these non-fatal injuries is a major undertaking. Stack [*23*] asks the right questions: "Is the reporting of these accidents vital in prevention? The immediate answer will be, 'Only if something is done about it.' If I as an individual doctor see a patient with, let us say, serious fractures and lacerations because of a defective electric tool or lawn mower or the like, to whom do I report?" It takes organization to get action on the information received, and that is why the different kinds of groups concerned must work together systematically.

Of course, in an epidemiological investigation the ideal is to have the number of accidents related to the actual population at risk [*24*]; on the other hand, we cannot afford to exhaust the time and money available for safety in the fact-finding. Reports of just a series of cases have been helpful; sound epidemiological investigations have made fundamental contributions. Small as well as large contributions can be made to the prevention of accidents and to the improvement of the care of the accidentally injured.

One indication of the close relationship between safety and surgery is the definition of a fatal accident [*25*]: "A fatal accident is an accident which results in the death of one or more persons within twelve months." Progress in surgery which helps to keep more accident victims alive also decreases the death rate due to accidents.

The American College of Surgeons and the American Association for the Surgery of Trauma have joined with the National Safety Council in a Joint Action Program to minimize accidents and the serious effects of accidents [*26*]. Dr. Paul R. Hawley, The Director of the College, and General G. C. Stewart, Executive Vice President of the Council, jointly direct the program; Dr. James B. Mason, Assistant Director of the College, and I provide staff services. State and local Joint Action Com-

mittees consisting of surgeons and safety council representatives are working together on activities selected for concentrated action: courses in safety and first aid, ordinances requiring first aid training for ambulance drivers and attendants, promotion of seat belts, or surveys of childhood injuries requiring surgery.

A subcommittee of the College prepared a questionnaire on the transportation of the injured which was included as a special section in the 1958 Inventory of Traffic Safety Activities conducted by the National Safety Council in 1,250 cities and forty-seven states. Recommendations to improve the immediate care of the accidentally injured is the initial objective of this activity.

Surgeons are making a unique contribution in respect to accidents involving emergency vehicles. Curry and Lyttle [27] studied a series of 2,500 consecutive ambulance runs and found that "there was only one case in which a moderate delay in transportation could have resulted in death," and that "in 1.8 per cent expeditious handling was considered necessary, but a speeding ambulance could have increased the severity of the injuries." Wade [28] sees the first step: "It is the responsibility of the medical profession to denounce the tradition of speed In transportation of the injured in ambulances. The speeding ambulance injures and kills more people than it saves." The next step will be taken by a subcommittee being formed to draft a model ordinance requiring that ambulances be operated under appropriate traffic regulations.

Surgeons make major contributions in their studies of selected accidents. Accidents in public places offer special opportunities for such studies. For example, Smith [29] writes of several skiing doctors who decided to do something about the safety of skiing from a medical point of view, formed the Northwest Medical Society in 1947, and evolved a list of specific recommendations for the prevention of ski injuries. "Well over half of present-day injuries need not occur," he concludes.

A number of medical and surgical organizations conduct important programs in safety. Some examples (listed alphabetically) are the American Academy of Pediatrics, the American Association for the Surgery of Trauma, the American Association of Plastic Surgeons, the American College of Surgeons, the American Medical Association and the Industrial Medical Association.

Their potential for accident prevention is tremendous. Brandaleone [30], for example, points out that "The industrial physician has the responsibility of evaluating the physical qualifications of commercial drivers through placement and periodic examinations and thus the unique opportunity to observe the commercial driver over a period of years and to compare his physical and emotional status to his accident record."

The American Medical Association, the Public Health Service and the National Safety Council are jointly sponsoring a program for the reduction of injuries and deaths in automobile accidents through the installation and use of seat belts in passenger cars. The sponsors and a large number of other agencies, groups and business organizations are supporting this seat belt educational program by employing their resources within their normal areas of interest and influence. Their first step is the installation and use of seat belts in their private and company passenger cars; then they are going to encourage others to do likewise. The sponsors are endorsing the use of seat belts manufactured and installed in accordance with the Society of Automotive Engineers Recommended Practice for Motor Vehicle Seat Belt Assemblies (SBA 4).

SUMMARY

Our traumatized society needs the joint efforts of people working in safety and surgery. There is wide agreement among experienced persons in the field of traffic safety that if the techniques now known and tested were fully applied, traffic accidents could be cut in half. Meanwhile, research is expanding to develop even more effective accident prevention programs. Kulowski [31] calls upon doctors to participate in the safety movement: "The epidemic number and variegated nature of motorist injuries and deaths are tending to pull all types of persons, groups, and disciplines together in a common effort to reduce this toll. Since the most significant results of motor vehicle accidents are personal injuries to people, medicine stands in the vanguard . . . "

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The Teaching of Trauma in Medical Schools

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THE incidence of injury is of such magnitude, the occurrence of accidents so widespread, and requirements for care of patients who have sustained trauma* is so urgent, that doctors of medicine are limited in their education if they have not had experience in the problems of trauma. Stated in another way, some education in relation to trauma is essential to all medical students at some time in their training program. Regardless of the type of practice, the specialty involved or the locality of the practice, it is difficult to avoid some contact with the problems of trauma even if it were desirable to do so.

There has been concern about the type and extent of teaching of trauma in our medical schools. As a subject in itself it is not listed as such in medical school curricula. During the war many medical schools established so-called first aid courses and more recently the MEND (Medical Education for National Defense) program has been established with federal support in many schools. The first aid courses served the purpose of presenting to the medical student the extent of knowledge of injury at least equal to that expected of a Boy Scout. This course consisted of the application of bandages and splints, and the cleansing of wounds, etc., and was often presented in the freshman year. The MEND program is even less concerned with trauma. It is primarily related to civil defense and problems related thereto. It must be obvious that the teaching of trauma in our medical schools must be broader and deeper if it is to be of advantage. MEND programs can and should, however, be integrated with the teaching of trauma for civil defense must needs be concerned with it.

Trauma is no respector of anatomic boundaries; specialty-board requirements do not encompass it. This subject, like cancer, runs the entire gamut of surgical experience and practice, involving all specialties. The so-called horizontal type of training, a period of time being taken out of the curriculum to present a broad subject, has been tried in relation to cancer and has been suggested for the teaching of trauma. Money is available for encouraging such experiments in teaching the care of patients with cancer which is not true of trauma. If funds were available to provide a coordinator for the teaching of trauma in medical schools, advances could be expected in this field as in cancer [*1*]. Experiments with horizontal teaching in cancer serve to indicate the ineffectiveness of such a program, but studies of the teaching of cancer therapy indicate the importance of coordination of effort in a major general area such as trauma.

Concern about the teaching of trauma to medical students is not of recent origin. This has been of some concern to the members of the American Association for the Surgery of Trauma for many years. Before World War II some attempts were made to determine the level of teaching of trauma in our medical schools with little information resulting. The conclusions were that trauma was not included in the curriculum of our medical schools and little attention was given it.

In 1955, Dr. Harrison McLaughlin (as chairman of a subcommittee to study this problem for the Committee on Trauma of the American College of Surgeons as well as at the request of the American Association for the Surgery of Trauma), inquired about the status of education in trauma in our medical schools through inquiry of many of the professors of surgery. He has generously permitted the use of this information for this presentation.

While impressions about the adequacy of training in trauma were not requested, it is of

* The phrases care of trauma, teaching of trauma and education in trauma are used hereafter to indicate briefly the care of patients who have sustained trauma and the teaching of such care.

importance that more than half of those answering indicated that teaching in trauma ought to be improved. Generous replies regarding material covered in surgical courses revealed that, in general, basic considerations of trauma were adequately considered. The subjects of shock and blood loss, infection and surgical bacteriology, burns, and healing of wounds, were included in all surgical courses in which course work was reported.

With regard to the matter of clinical contact and experience with the active care of trauma it was obvious that this phase of the teaching of trauma was limited in most schools, and completely ignored in many. Assignment to the emergency service, in which the student took part in the care of patients with acute injuries was reported in but twenty of the forty-seven responses received. The period of exposure was in some instances no more than four days, but in others there was assignment once weekly for three months. Assignment of students while they were clinical clerks on the ward to patients who had sustained trauma was mentioned in instances, as an occasional opportunity for the student to learn about trauma but with no indication of an attempt to stress the subject.

The inquiry did not reveal information about all schools, but the forty-seven schools supplying information were a fair cross section. The information was not the result of a questionnaire with specific information requested. A brief description of the plan and content of the teaching of trauma was asked for and the assumption was clear in the request that teaching of trauma to the medical student was not considered adequate.

The implication that the teaching of trauma was not at a high level brought forth comments mostly approving this concept; some defended the adequacy of their program but not too strenuously. More commonly, there were indications that improvements in the teaching program in trauma could and would be made. The questionnaire stimulated thought and interest in the problem of education in trauma with indications that improvement might result.

Larger urban universities, as a rule, had more experience in acute trauma for their students than those in smaller communities. This obviously related to the larger percentage of patients who had sustained trauma among their patient population. Even in universities in large cities, however, there were instances of small numbers of injured patients for the students, and little concern with the matter.

In institutions in which large city hospitals with active emergency services are the principal teaching hospitals of a medical school, as at the University of Louisville, the University of Cincinnati, the University of Tennessee and Wayne State University, the experience in the care of trauma is by matter of necessity an important part of the surgical teaching program. Large numbers of patients injured in accidents must be cared for regularly and contact with such patients is routine. In hospitals in which patients injured in accidents are less commonly seen, the problem of providing experience in the care of trauma becomes one requiring organization, so that utilization of all instances of trauma to the best advantage for teaching requires special effort. One splendid example of such organization for the teaching not only of medical students but also of internes and residents, is described by Cole and Schneewind [2]. This embodies not only planning in the curriculum for the teaching of trauma, but provision for a well planned and organized emergency facility.

Institutions in which new construction or available space for such a well organized facility was not originally planned, can, nevertheless, by careful utilization of those instances of trauma which are available, create a creditable educational program in the teaching of trauma. Some accident material is available to all University Hospitals even though there may not be many patients who have sustained trauma and their admission, by nature of the condition, may be quite irregular and unpredictable for adequate scheduling. As an example, at the University of Iowa there has been a program of planning for clinical teaching of trauma which utilizes material from all the specialty services as well as general surgery to provide a coordinated program of presentation of the acutely injured patient, as well as the sequelae. In addition to those instances of trauma seen for work-up in the clinical clerkship during the junior year, a surgical clinic is held once weekly, and for two trimesters these are devoted to traumatology. Patients with fractures are treated by both general surgeons and orthopedists and there are joint conferences biweekly with staff and students from both departments. In addition, senior students are assigned to the emergency room [3]. This re-

quires not only an interest in the subject on the part of the faculty, but a willingness to spend the additional time to present in a coordinated fashion the problems of the injured patient. An additional and important requirement is that someone take the responsibility for coordinating such a program, not only to utilize what teaching material is available but also to assure adequate teaching staff for the purpose. Other university hospitals located in smaller communities have evidenced interest in the teaching of trauma and while their programs may not be so well planned, many are making some effort in the organized clinical teaching of trauma.

With a large number of patients who have sustained trauma available, the problem of education in this area is not so difficult, but even here organization is required. It is obvious that even in institutions in which the "trauma case load" is limited it is possible with proper utilization to present at least good basic concepts in the care of trauma. Education ought not stop with graduation, and education in trauma may be supplemented by internship in an institution in which there are adequate numbers of victims of accidents and facilities for their care. Many hospitals with good emergency services offer internships and these are not all confined to large city hospitals [4].

For the student who has had his training in one of the many medical schools in which few patients who have sustained trauma are seen, or in which a decided effort has not been made to utilize to the fullest what trauma material is available, it would seem wise that such a serious defect in medical education could be corrected by obtaining an internship in a hospital in which adequate material and good teaching facilities are available.

The need for good education in trauma in our medical schools is of growing importance for the problem of trauma is becoming increasingly serious. Trauma is our most urgent health problem. It is our most important health problem in relation to the active, most useful period of the lives of our people. Strenuous attacks on the problem from a preventive standpoint have not decreased its importance, and good care of patients with accidental injuries ought to be of concern to everyone. Doctors of Medicine are of paramount importance in controlling death and crippling and therefore occupy a key position in the over-all safety program. Trauma cannot be divided into public safety and medical aspects. These are one and the same problem. Our medical schools must prepare our doctors of medicine not only to meet this serious problem but also to make definite progress towards better and better care of the injured. This is a pressing challenge, one to which medical educators must rise, and one which the public must be expected to support financially. Before financial support can be expected for research and education in trauma, we must develop better and more general interest and effort in our medical schools and hospitals.

Basic aspects of the problems of trauma are presented by surgical departments in almost all our medical schools not because of a direct relationship to trauma, but because these subjects are fundamental to surgery. The application of these surgical principles to trauma gets short shrift as a general rule in medical education, and the average doctor, as well as many surgeons, are limited in their knowledge about the proper care of the injured patient. No amount of warning to the public concerning avoidance of accidents can correct this deficit. The injured we have with us always and the salvage rate can only be increased by better care. This can only be accomplished by better training of the medical profession, which must have its beginning in undergraduate medical education.

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Cripples Don't Creep Anymore

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THIS discussion concerns the skeletal cripple—the automobile driver whose impairment lies in the orthopedic field. Our word "cripple" is a derivation from one of old English, meaning "to creep." It is immediately apparent that such a definition is strikingly anachronistic, for in this era the cripple may do anything but that. He, like all others, took advantage of the invention of the wheel. He may direct wheels and their vehicles driven with his own power, or natural sources such as wind and current, or automotive forces of varying power, speed and ability. For our purposes, the skeletal cripple may be defined as one who, because of disease or disorganization of his neuromusculoskeletal tissues, has apparent or occult impairment which, in his natural environment, sets him apart from the so-called normal. (However, in his own particular local environment he may even be set apart by excellence.) In an automobile, truck, bus, airplane, or sailing or motor boat (and there are those who argue that today this is a natural environment), however, his impairment cannot be known to those associated with him in the daily project of getting from one place to another on our highways, airways and waterways. An exception to this, or course, is the special disabled veteran's automobile license plate but, in general, there is nothing to tell one driver that the driver of the car ahead, behind or dangerously close to the side is using hand controls, has a trick knee, or is restricted in rotation of the neck.

Perhaps the term "skeletal cripple" is an unduly harsh one to use in describing a person whose disability may, under usual conditions, be mild or even non-disqualifying as far as his job is concerned. Maybe at worst his trouble is only intermittent. Nevertheless, he must be included in the over-all look that many government and responsible private agencies are taking at traffic safety. His role in the production of 5,000,000 non-fatal injuries (these are defined as those which required medical care or disability beyond one day) and the 43 per cent of the 94,350 accidental deaths that occurred in this country in 1956 is going to be determined if at all possible. It is not known now. It is known, however, that the leading age group in the production of the 5,000,000 non-fatal injuries was fifteen to twenty-four, with males predominating, and the problem is made more difficult if we accept the fact that the majority of musculoskeletal cripples can hardly be found in this age group. It should also be remembered that accidents are the leading cause of surgery in young males with the exception of tonsillectomy.

The Committee on Orthopaedic Standards for Drivers of the Medical Society of the State of New York has recommended that state licensing authorities, whenever possible, maintain separate files on all drivers who use special controls on vehicles. They further suggested that the Veterans Administration, with state motor vehicle administrators, conduct a study of the driving records of these individuals [*1*].

If one sets out to put down a set of rules to guide physicians in qualifying or disqualifying those who wish to drive on our highways, those rules concerning the neuromusculoskeletal system would seem, at first glance, the easiest to devise. Abnormalities of this system are more apparent than those of the cardiovascular system, for example, and certainly easier to detect than the epileptic equivalents. The driver with musculoskeletal impairment must be able to do certain things, and his ability, or lack of it, can usually be readily noted. He can be made to show what he can do, but to dismiss the wide range of orthopedic and neurologic conditions which may disable a little or a lot on this basis is perhaps an oversimplification of the whole

problem. Dr. E. L. Kelly has stated, "When we start talking about restricting the privilege of driving an automobile, we run into political and social problems of a real magnitude; hence, before we experiment with more vigorous enforcement measures or more restrictive licensing requirements, we must have a more firm knowledge on which to base this action." For example, Ottawa, Illinois (population 16,000) and Watertown, Wisconsin (population 12,000) are two communities of good size (and there must be many more) in which there is no public transportation. Dr. Kelly goes on to say, "There are many kinds of accidents and it seems likely that accidents have more than a single cause. Because of the very large numbers of factors that influence driver behavior, physical, environmental, sociologic, economic, etc., it is clear that anything less than a broad-scale research approach to this problem is not likely to pay off. Furthermore, because of the nature of the problem, we are convinced that no one discipline and no one approach is likely to do more than make a dent in the solution" [2].

Those of us dealing with people who have musculoskeletal difficulties believe that such persons are more alerted to their impairments simply because they, too, can see them, and they are dealing constantly with reality and not with potentials. There are no figures to show how these people fare in accidents as compared to others, but it is believed that the alertness that will guide them when walking on an icy street will also be with them in dense traffic. They are, perhaps, more likely to know their limitations and to pace themselves accordingly. The advised cardiac patient does not want to make his final act that of shoveling snow, and the orthopedically handicapped patient does not want to make his that of passing on a hill.

Some excerpts from the Williamsburg Conference of the President's Committee for Traffic Safety project further the idea that the person in the car, however handicapped, is not the sole consideration. In a symposium devoted to research needs, it was asked, *Why is the car a non-social device?* The possible answer: It has been institutionalized historically to embody extraneous motivations, power, prestige, etc., and to serve as a means of expressing them. *Why is much safety propaganda ineffective?* It is regarded as a limitation of the more powerful motivations embodied in the car. *Why is the automobile an institution refractory to social restraints?* The automobile subculture has acquired such momentum as to escape from previous controls and has introduced strain and disequilibrium to a degree that seriously threatens our society [3].

The musculoskeletal cripple may have episodes of imbalance or emotional turmoil that is not uncommon to any physical deviate. His burden has been greater because of its obviousness, but for him to take it out on those involved in traffic situations with him is not as likely as for those whose problems are less obvious or even unknown to them. The obviously abnormal person is likely to be better behaved in traffic not only because of a natural fear of the consequence of poor behavior but also because of a desire to show his excellence despite the handicap. He may well be having his problems in being accepted socially and his likely want is to show that in being a reliable driver the community is more likely to accept him as a good citizen.

An American Medical Association Committee on Medical Aspects of Automobile Injuries and Deaths has been concerned, since 1955, with, among other facets of the problem, the physical examination of those whose ability to drive safely might be questionable. They have published a guide to aid physicians in advising patients who are in this category. As a recipient of this guide and a practicing physician, I would like to review the section entitled "Surgery and Orthopaedics." It is quickly discerned that there are two types in this orthopedic group: those who have skeletal vulnerabilities without real impairment that expose them to injuries to themselves alone in a single car accident, and those with impairment without any particular vulnerability who might be a hazard to others. An example of the first type is the senior citizen with an osteoporotic spine, and of the second type the amputee with special driving attachments. This division seems wise because one cannot dissociate the emotional from the orthopedic factors in the two types. The driver with poor control of an underlying hostility is more likely to be the proximate cause of injuries to others, with or without injury to himself, while one with self-anxieties is less likely to be the causative factor.

The logical first step of those responsible for alerting the physician to his responsibilities in these matters is to prepare a set of rules.

Necessarily, such rules will run the gamut from the perfectly obvious and common sense example to the most subtle. The many overlappings from one specialty to another is readily appreciated. This guide recognizes three types of vehicles: the commercial transport, the passenger transport and the private car. The real problem of the private physician lies with the driver of the private car. The drivers of commercial and passenger transport vehicles are likely to have pre-employment and periodic examinations to determine their fitness, whereas the private driver may turn to his physician for an opinion as to his abilities. The person with obvious skeletal deformity or malfunction is not likely to be employed or continued as a driver in the commercial and passenger transport field because of the public relations aspect of this job. The traveling public is much more aware of the bus driver than they are of his counterpart in the locomotive cab and the airplane cockpit. Also, the examining physician for the bus or trucking company is in a position to be firmer than is the private physician with his private patient. The former may reject, based on a set of standards dictated by the past experiences of his company. The latter's advice is based on standards with which he has had little or no experience up to this time at least. Seemingly, another factor would be the reluctance of the moderately impaired person to discuss the matter willingly with his physician for fear of getting an unfavorable response. I have never had a patient come to me for the express purpose of determining his fitness to drive his own car, and in this era of the "subculture of the automobile," few such inquiries can be expected. However, the question of the ability to drive at a given time comes up frequently in patients who have been under my care, and it is striking how few times there is disagreement on this subject. A moderately intelligent person with a skeletal impairment seems to know how foolish it would be for him to attempt to drive. He has no doubt given it much thought and, in a way, he is like many of those with malignancy who do not have to be told in so many words.

The American Medical Association Committee comments that "specific requirements are best considered from the standpoint of body regions as they relate to the static and dynamic demands upon the driver of a motor vehicle" [4]. Following this line, they discuss the cervical, dorsal and lumbar spine, the upper and lower extremities, and the stability of joints. After reading this guide, those interested in the driving problems of the skeletal cripple will notice that much has been necessarily left unsaid, that much has been left to the judgment of the physician. The family physician with no backlog of company experience to follow may be sorely tried, as it is "manifestly unreasonable to generalize about the effects of various body disorders on all drivers. The paraplegic driver, especially trained and provided with specially-equipped vehicles, may excel the so-called normal drivers in safety records" [5]. It is interesting to note that in a symposium on the medical aspects of motor vehicle accident prevention there was but one minority report. The symposium was presented by divisions into anatomic systems and disease entities, and each was represented by a committee. The dissention occurred in the general medicine committee. The majority group believed that the committee was not in a position to bring in specific recommendations relative to organic physical deviations from the average "because of a lack of comprehensive data on the effects of many organic physical defects in the causation of accidents." They recommended that "interested groups in association with representative members of the medical profession undertake studies to determine specific disabilities which would limit an individual in the operation of an automobile." The minority group, composed, interestingly enough, of the industrial physicians on the committee, believed that "a list of interim criteria for driver fitness can be established immediately on the basis of knowledge and experience without waiting for the results of further research in areas of insufficient knowledge." They go on, "Industrial physicians have shown the value of medical criteria in driver selection in industry. The application of such criteria to the selection of all drivers would be beneficial in reducing the accident rate and would assist the licensing authorities."

It is obvious that these two opinions on the relationship between physical defects and traffic accidents point up the divisive factor, which is "knowledge and experience." Some have it and others do not. Perhaps this "knowledge and experience" will come to all physicians when licensing authorities make mandatory a physical examination of all drivers involved in accidents. The defects noted can then be referred

back to the original treating and/or examining physician for evaluation and recommendation. In this way the physicians of the country will be better able to "influence the development of sound medical standards for driver licensing." This is one of the areas in which Dr. J. L. Goddard, Chief of the Accident Prevention Program of the U. S. Public Health Service, says the physician can play an important role. He can "teach while treating" [6]. Without such a system the physician who does not have industrial contacts involving commercial and passenger vehicles can hardly gain the knowledge and experience necessary to play this role. Were such a system of accident driver examination and follow-up set up, it is not unlikely that local medical specialty organizations would be anxious to keep the record good for patients in their own specialty. Might not the orthopedic surgeon be more interested in the axiom, "teach while treating," if he were concerned not only with the end result obtained but also with the general traffic accident record in his community of all those with neuromusculoskeletal disorders? It is possible that such a program would be suitable for the local and regional committees working in the joint-action program of the National Safety Council, the Trauma Committee of the American College of Surgeons and the American Association for the Surgery of Trauma. On the agenda at each meeting of this group could be a review of the physical and emotional states of the drivers involved in significant accidents in their community.

Like gestation, the solution of this problem of driver health and accident prevention will probably require irreducible time, but let us remember "the difference between a true solution and an *ad hoc* improvisation or concession to expediency" [7]. As a result of my own experiences with this problem, and after reading many of the papers dealing with the truly basic research involved, I have a strong feeling that in the end the finger will not point to the musculoskeletal cripple as the medical culprit.

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The Armed Forces Fights Injury Everywhere

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THE United States Armed Forces is a highly organized and equipped group of individuals charged with the responsibility of being in a state of constant readiness to defend our nation against any aggressor. From the moment of entry into active duty, each man and woman selected for this important service undergoes specific training to meet such eventualities. This training is continuous. It is both mental and physical, and is carried out under strict discipline and competent leadership. The individual becomes part of the whole and secondary to it. Incompetence is incompatible with this responsibility and must be corrected or eliminated. To execute assigned duties promptly and efficiently implies a physical toughness and mental alertness approaching perfection.

The Medical Department of the Armed Forces is charged with the specific mission of maintaining the health of uniformed personnel at all times and under all circumstances. The medical problems of the military are not unlike those of civilian medicine, for today care must be provided for all ages and both sexes. Military cantonments are planned communities, complete in detail and essentially self-sustaining. Sickness or injury causing non-effectiveness to Armed Forces personnel is doubly expensive. Reduction of troop strength because of sickness or injury reduces the effectiveness of any unit. Permanent disability not only means monetary loss to the government through loss of services but also is a waste of the training costs which may be considerable. Temporary disability affects unit effectiveness and is likewise expensive.

There are two special fields of medicine considered to be particularly important to the Armed Forces. The epidemiology of disease is under continuous surveillance. Epidemics are highly sensitive problems and must be prevented at their inception. Mass assembly always increases opportunities for disease through cross contamination. Disabling injuries, particularly those due to preventable accidents, are equally costly and to be avoided. The medical-technical services and those charged with command responsibilities maintain an awareness of these major problems at all times and campaign against them.

Although the key word is prevention, breakthroughs are repetitive. Communicable diseases require prompt isolation. The toughening of troops for combat requirements embodies emphasis on physical stress which is always accompanied by calculated risks. Some injury is to be anticipated and the hazards of physical training are understandable. The military surgeon is trained to be proficient in the management of a great variety of injuries, including those due to enemy action. He must be prepared to do so under both optimal and adverse circumstances. It has been well demonstrated that properly trained and disciplined troops sustain fewer injuries on the base or field of combat than "green" troops. The same is true for many disease entities.

In general, mechanization of the modern Armed Forces has added to the problems of both prevention and treatment of combat and non-combat injuries. Vehicular injury occurring in the line of duty cannot be avoided completely. A continuing educational program to keep alive an awareness among all military personnel of the dangers and penalties of accidental injury is a major command responsibility. The prevalence of off-duty, motor vehicle accidents involving military personnel which result in incapacitating injury is alarming to all concerned. The annual financial loss within the three major services caused by such accidents amounts to tens of millions of dollars,

exclusive of the economic loss to the family of the victims.

This particular problem affects the military population just as it does the civilian. Proportionately it is frequently greater by as much as 30 per cent [1]. During 1957 there were over 38,000 motor vehicle deaths in the United States. During this same year there were approximately 1,350,000 casualties requiring hospitalization from the same source. For that year the United States Navy [2] reported a motor vehicle accident death rate among its personnel of one every fifteen hours, and one corpsman admitted to a medical facility every seventy-six minutes for treatment of injuries caused by motor vehicle accidents on the highways. The average daily hospital census of motor vehicle accident victims for that year was reported to be 853. It is significant that approximately 98 per cent of these injuries occurred on the highways and were unrelated to duty. The report states that in terms of training investment by the government, the total years in service accumulated for those killed in motor vehicle accidents was equivalent to two and a half centuries of time. In general, the day by day experiences of the Army and Air Force in this regard parallels those of the Navy.* Approximately one-third of these injuries and deaths occurred when the car with its passengers was driven off the road. This would seem to place the responsibility, for one reason or another, on the driver. An additional one-third of these injuries resulted from collision of one vehicle with another and might well be attributed to faulty judgment and carelessness.

As stated previously, the Armed Forces have a particular interest in trauma and its management. One might summarize this interest and experience by calling to attention several basic considerations. Actually, the problems are both military and civilian. Modern Armed Forces are constituted preponderantly of temporarily mobilized civilians. Even if this were not true, modern wars are frequently directed at industrial centers. Trauma, therefore, is everyone's concern and the principles for its management are essentially the same everywhere.

Man, in his continuing struggle to survive, is in constant conflict with his environment. He is subject to a great variety of diseases, many of which defy his efforts to prevent or combat their deleterious effects. He is also subject to a great variety of injuries due to violence. Most of his injuries result in some degree of incapacity and many of them prove to be fatal. He progressively improves his methods for the detection, prevention and management of his diseases. Today he is armed with potent chemotherapeutic agents and is in possession of methods for his successful immunization against many of the pathogens that infest his environment.

He has not been as successful with the management of injury. Because of its ubiquitous nature and precipitate occurrence, he frequently has little or no time for evasive action. He possesses no specific antidote for injury, and his only means of immunization against it is prevention to control its incidence. Unfortunately, he is prone to carelessness and overconfidence, both of which serve as pitfalls for his sudden entrapment. Although none are immune, people at the extremes of age are particularly vulnerable to injury. Medical literature makes reference to accident proneness and the epidemiology of trauma.

Accidental injury as a cause of disability and fatality is a rapidly growing national problem. Well over ten million accidental injuries are recorded annually in this country. Trauma is the major cause of death for all persons under the age of twenty-five. It would appear that as more and more of man's diseases are conquered, trauma becomes a more important protagonist for it is seemingly on the increase everywhere. During the Korean conflict, more deaths were caused by motor vehicle accidents on our public highways than those due to enemy action.

In attempting to rationalize this major problem, several provocative reasons suggest themselves. Certainly the relationship between trauma and motion is more than a mere coincidence. Man is restive by nature and much of his time is spent moving about. This fact exposes him to greater probability for injury. He continually seeks ways of adding to his comfort by reducing his expenditure of physical energy. He is mechanically minded and enjoys automation. He constantly seeks faster and faster means for his transportation. He seems to be obsessed with a desire for speed and at times it would appear he is determined to equalize time with space. He certainly has harnessed power far in excess of his essential needs. Thus

* According to the U. S. Army Safety Program, Annual Report, 1955, nearly three-fourths of all injuries due to motor vehicle accidents among U. S. Army personnel involved non-Army motor vehicles. Similarly four of every five deaths involving motor vehicle accidents were caused by non-Army motor vehicles.

his confidence in machinery of all types abounds, yet he has learned that in a moment's lapse of vigil any one of them will turn on him with fury. As if for appeasement, he surrounds himself with signs of warning and caution which he promptly ignores. In consequence he must repeatedly rediscover that the basic laws of inertia are inexorable. The season for injury to man is always open at home, at work, even while he sleeps. The pedestrian on the street becomes more and more vulnerable to accidental injury and is always a prime target on the highway. The automobile can be just as lethal as the enemy's missile.

Unfortunately, man is made to suffer from the whims of nature and the sudden release of the pent-up forces which are concealed therein. Earthquakes, fires, floods and storms descend upon him with little or no warning. These freaks of nature are responsible for many of his disastrous experiences. The common impression that these phenomena are on the increase fails to take into consideration that our population increases annually and becomes more and more dispersed. In consequence, the free space available to nature as a harmless playground becomes smaller and smaller. In other words, disasters are related to people and are so graded as to their severity. Today more and more communities are being made to realize that these storms of violence are not selective but can occur almost anytime on land, on sea, or in the air.

Man also continues to live in a state of war with his fellow man. He recognizes cold wars of tension and suspicion which suddenly flare up as brushfires, knowing full well they may explode into major conflicts involving many nations. Even while he prays for sustained peace, he finds it necessary to protect himself against his enemies by spending more and more of his earnings for insurance against war or perfecting instruments for its successful prosecution if there be the need. His history is marked by wars, both minor and major.

Today all mankind is frightened while living in an atmosphere of international tension and uncertainty. The newly revealed power hidden within the atom is known to have fantastic destructive capabilities when adapted to instruments of war. With the speed of a brilliant flash of light, entire cities have been demolished and many living therein killed outright or crippled and made homeless. Diabolical devices of varying denomination exist and can be hurled great distances at supersonic speeds with amazing accuracy. Ionizing radiation of the entire body, a by-product of this phenomenal energy, presents a new medical challenge which at present is shrouded in great mystery. Whereas atomic energy for peaceful purposes abounds in great potential goodness, this goodness remains tainted with the fear that one day lethal radiation could blanket the earth, thus permanently altering our civilization. Unfortunately, in the nuclear war of tomorrow one can foresee no certain avenue of escape for those within the range of exposure. Because at present we have no specific agents for neutralizing the effects of such radiation on body tissue, much of our thinking must be directed toward the problems of the mechanically injured survivors (due to the blast effects) and those who have experienced thermal burns (from the intense heat which is released at the moment of detonation). The medical problems of these casualties alone would be tremendous even when uncomplicated by the effects of radiation. As frustrating as these problems may appear to be, they are in need of sober reflection and serious consideration while they are yet dormant. Distasteful as they may be, they remain in need of resolution. Proper management of trauma is no longer "nice to know" but "necessary to know."

In any catastrophe the immediate concern of those who rush to the scene is that of rescue and care of the injured. Following any major disaster, it is not uncommon for many casualties to be suddenly thrown on the local medical facilities for definitive treatment. Such challenges and the problems they present are vastly different from those presented by the individual casualty or the few occupants of two motor vehicles which have collided on the highway. The sorting of casualties in terms of priority for treatment is a basic requirement when many casualties is the immediate problem. The time lag between injury and effective treatment other than first aid has a direct influence on the survival rate and recovery time. The disparity between work load and medical capability is invariably a frustrating experience until the inequality becomes balanced and proper treatment is assured for all. Prior planning and organization for such eventualities continues to be the responsibility of the medical profession. First aid at the scene of the accident frequently can be more life-saving than the surgical skills

available several hours later. The home or the highway can become the operating room.

There is little any of us can do to prevent the disastrous effects of earthquakes, floods, tornadoes and other devastating natural phenomena except to give early warning to those whose lives are endangered and provide means for their evacuation to safety. There is very little most of us can do to prevent war and its disabling consequences. However, most day-to-day accidents, and certainly those taking place in traffic on land, sea or air, are preventable. Such unwarranted destruction becomes the concern of all, and a significant reduction in its incidence can only occur if all assume a personal responsibility to assure safety for himself and those entrusted to his care, directly or indirectly.

In summary, the Armed Forces is concerned with injury at all times, for its basic tools are instruments of destruction and its personnel are chronically plagued with injury. Although its purpose is to destroy our enemies, it is frequently required to assist in major disasters. The required special training exposes its personnel to more than the usual opportunities for injury. However, the privately owned automobile is not standard equipment. The three-day pass, or liberty, is permissive. Unfortunately, this privilege becomes a temptation to become careless while traveling on the public highways. In consequence, the motor vehicle accident injury and fatality rate among Armed Forces personnel remains excessively high. It would appear that the automobile has become the soldier's common enemy. Certainly, to that extent, he is just as undisciplined as his civilian brother.

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The Patient, the Attendants and the Externals in Traffic Hazards

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Neurosurgeons, neurologists and psychiatrists see many of the direct and indirect effects of traffic accidents, ranging from injuries to head, spinal cord and nerve roots, through post-traumatic organic and neurotic sequelae, to the emotional traumatization of children through death of their parents. The fields of neurology, neurosurgery and psychiatry can contribute to the prevention of this tragic menace to health and happiness as well as to the treatment of those who have been afflicted.

One of Hippocrates' aphorisms enjoined that "the physician must not only be prepared to do what is right himself, but also to make the patient, the attendants and the externals cooperate." In the sequence of ill health and unhappiness which is punctuated in its stage of eruption by a vehicular crash, the following are some of the patients, the externals and the attendants. The patients are those who are injured, who may or may not have had prodromal symptoms leading to the eruption. The externals include those carriers of the disease who had prodromal symptoms leading to the eruption, who were not injured in the crash and who never became patients. The attendants include those representatives of society, such as lawmakers, physicians and automobile manufacturers, who allow the patients and externals to drive in inadequate vehicles and in spite of being carriers of the disease, without insisting on prophylaxis as a prerequisite for driving. The externals and the attendants also include all who contribute to the complications following the injuries inflicted upon the patients.

Our thesis is that "the patients, the attendants and the externals," leading to and following automobile accidents, can be discovered and made to cooperate to a greater degree than presently exists. This paper presents some neurological, neurosurgical and psychiatric considerations toward this goal, in regard to both prevention and treatment.

PREVENTION

Neurosurgical Aspects. The preventive aspects of traffic hazards, from the viewpoint of the neurologist and neurosurgeon, fall logically into two phases: (1) prevention of injury after the crash and (2) prevention of the crash. The first has to do with the efficiency of the vehicle, the second with the efficiency of the operator.

Automotive and highway engineers have come far in the perfection of safety features that tend to lessen the incidence of highway traffic accidents by providing better road surfaces, better traffic control and the development of such features as better brakes, steering control, tires and roadability of the vehicle. With few exceptions, however, these attendants have not succeeded in persuading the carriers to buy and use those safety features that proper packaging can provide. The comprehensive work of Moore at Cornell [2] and the heroic experiments of Colonel John Stapp leave no doubt that proper packaging of the passenger will permit survival and minimize the injuries that result from the overwhelming majority of traffic accidents on our highways. One manufacturer made a profound effort, in collaboration with the medical profession of this country, to sell these features to the "carriers," but without significant success [14]. Properly cushioned interiors and adequate restraining devises are of major importance, from the standpoint of the neurologist and neurosur-

geon, for injuries to the head and spine account for more than 70 per cent of the deaths and injuries that occur on our highways. While the response of the carrier in accepting and using these devises has not been enthusiastic, efforts at promotion of these features should not be lessened.

The role of the neurologist and neurosurgeon in the prevention of the accident is concerned with the fitness of the individual as a vehicle operator. There are many neurological disorders that render one unfit to operate a motor vehicle with reasonable safety, yet the identity of these disorders requires intensive neurological observation and also a comprehensive history from the patient and his family. Many of these would escape recognition from even the most skilled neurologist if the patient were hostile or evasive. This might prevail if the examination were being done for the purpose of obtaining a license, which most citizens of this country have come to regard as a necessity. Furthermore, the number of people involved makes it unreasonable to hope that all applicants who attempt to obtain a new or renewed driver's license be subjected to a comprehensive physical and neurological examination.

With rare exceptions, however, those with defects are already a matter of record in some physician's office. This information, if available to the licensing authority, would appear to constitute an adequate screening, for those with known defects could be examined in detail. The insurance carriers have long required the applicant for life, health and accident insurance to place his medical history on record in order to be insured, under the penalty of finding his insurance void for misrepresentation. It would seem reasonable for the carrier of liability insurance to require the same of an applicant. If the licensing authorities required this also, under penalty of criminal prosecution for misrepresentation, the work load might be brought to a reasonable level and the rights of the citizenry as well as of the individual protected.

Perhaps under such a program those people with recurrent bouts of coma or vertigo, such as epilepsy or Meniere's disease, would be recognized, and those who are controlled with treatment could be licensed. It seems probable that patients with disorders characterized by remissions, such as multiple sclerosis, would be recognized, and certainly patients with cerebral ischemia, brain tumor and other disabling diseases would rarely escape attention.

Psychiatric Aspects. There is a crude epitomization of the importance of human as compared to mechanical factors in the production of crash injuries in motor vehicles. It is the statement that the "nut" behind the steering wheel is more crucial than the nuts and bolts in the chassis. These "nuts" are not usually psychotic or certifiably insane. They have personality characteristics which lead them to take excessive risks, either chronically or at times of particular stress [*17*]. Such personality characteristics can be detected in many cases. Are we, as physicians and surgeons, making "the patients, the attendants and the externals cooperate" in the prevention of traffic accidents if we do not urge that examination for such personality characteristics be prerequisite to the granting and renewal of licenses to drive?

It seems as if there is an assumption that any adult without gross and obvious physical or mental defects has a God-given right to drive if he can demonstrate that he can handle an automobile mechanically. Surely those who wrote the Bill of Rights did not intend the right to bear weapons to include placing that deadly weapon, the twentieth century automobile, in the hands of those whose conscious or unconscious disregard for safety would jeopardize the lives and limbs of many others.

What are the personality characteristics associated with repeated motor vehicle accidents? Tillmann and Hobbs [*18*] and McFarland and Moseley [*10*] have shown that drivers with repeated accidents are different from accident-free drivers in regard to features, on record with public agencies, indicative of social maladjustment. In fact, 66 per cent of the accident repeaters were known to such agencies as compared to 9 per cent of those who were accident-free. Furthermore, 85 per cent of accident repeaters could be identified, in an unselected sample of drivers, by weighted scores of items already in the records of courts and business bureaus. In general, those having repeated accidents are those who have a disrespect for organized authority, poor social adjustment, evidence of permanent or transitory emotional instability, and more detailed psychodynamic constellations which are detectable by sophisticated, but simply administered, psychological tests [*1,4,9*].

How can such personality characteristics be

discovered at the time of application for license or renewal of this? First, a check can be made of court and credit records. Second, psychological screening tests can be applied which sample emotional patterns not known by the subjects to be associated with high accident risks. Finally, those persons picked out by these methods could be interviewed toward a more comprehensive assessment of the risk entailed in granting a license to drive, including, as only one of several sources of information, a report on physical and emotional health from the person's own doctor.

One of us (F. H. M.) has raised the question as to the doctor's responsibility for the use of information concerning patients which bears on their safety as drivers [7]. Apart from our regard for privileged communication, which is essential for us to obtain the frank and confidential information we need in order to help our patients, we, in our role as practicing physicians and surgeons, are biased in favor of the persons who seek our help, even at the risk of overlooking the repercussions on others of giving our patients the benefit of the doubt. Moreover, we would not like to support any bureaucratic prohibition of driving, for all time, to persons with physical, mental or emotional disorders who have obtained treatment, and who then may be less prone to accidents than those who have not been under medical supervision.

However, we might well subscribe to the statement that "the most effective approach to accident prevention is through active, planned use of methods available only to the medical profession" [3], if we also recognize the value of methods available to the psychological profession for detecting characteristics which can be assessed further for their physical or emotional causes.

Do we not need some division of responsibility on these decisions for driver licensure, since they affect both the patient and the society in which he drives? It would seem that a more frank report could be made by the patient's doctor, with the patient's permission, if the decision for licensure were to be made by a specially qualified authority, using medical, psychiatric and psychological advice, independent of the patient's own doctor, and if refusal of license were temporary, pending adequate medical or psychiatric treatment, to be arranged by the patient's doctor, before re-examination would be undertaken. Such a division of responsibility would reduce the pressure on the doctor to make a decision in favor of his patient's short term interests. It would free the doctor from any risks of malpractice suits which might be inherent in making a decision against driver licensure a function of private practice. We already have the pattern for such division of responsibility in the cooperation between occupational physicians and private practitioners in the assessment of and treatment recommendations for persons incapacitated for work, who are drawing disability benefits which affect the insurance premiums of their fellow employees.

Such a system of medical and psychological standards for fitness to drive [11,12] would "make the patient, the attendants and the externals cooperate" in the reduction of one of the greatest current menaces to public health [16].

TREATMENT

Neurosurgical Aspects. The treatment of patients who suffer injuries to the head or spine does not depend upon the cause of the injury, and hence a detailed discussion of treatment is not considered within the scope of this paper. The influence of the so-called whiplash injury, however, does warrant comment, for under this title one is apt to find catalogued all unexplained symptoms following cervical trauma, whether fractural, functional or feigned.

Perhaps no medical subject evokes more prejudice than this. Gotten [5] reports that 95 per cent of patients with whiplash injuries recovered as soon as their claims for damages were settled. He did not report the fate of the other 5 per cent. Others [6,8], however, have reported cases of trauma to the upper cervical spine and extrusion of cervical discs from this type of injury, when compensation was not a factor, in which chronic pain converted stable, well adjusted citizens into emotional derelicts until their pain was relieved by surgical means. This group of patients requires most detailed study, lest one overlook tissue changes that would respond to therapy or lest the examiner, by his own concern, add to the anxiety of the injured or be duped into documenting false claims of the malingerers.

Psychiatric Aspects. Any major accident, whether productive of a physical injury or not, may be accompanied by emotional trauma. There is a very definite psychiatric syndrome

which is precipitated by an overwhelming threat to life or limb for the patient or for someone of emotional importance to the patient. This used to be labelled traumatic neurosis. It is now included within the category, in the official nomenclature, of *gross stress reaction*.

"Combat neurosis" is well recognized in military medicine and surgery. Its civilian equivalent is often overlooked, especially if attention to physical injury has, quite properly, held the center of the stage. Nevertheless, there are characteristic symptoms and signs of this disorder which should not be confused with the features of a compensation neurosis or an insurance neurosis, which can be a sequel at a later state [*15*].

A person may appear to be in full possession of his faculties throughout the accident and yet report afterwards an amnesia for the terrifying incident from the moment of the realization of the threat until some point of relative security later. The specific features of a traumatic neurosis can be picked up by a careful history. The driver felt numbed, or "shocked" (in the popular sense of the word), and then later restless and irritable, with an increased startle reaction to sudden noises or changes. He usually had insomnia during the night following the accident, or the first of recurring dreams, repeating the circumstances of the threat, which may have continued as the hallmark of this disorder for weeks or months afterward.

For example, the dreams of approaching headlights, of the screech of brakes or of the impact of steel and the shattering of glass may have been so disturbing that the person was unable to sleep without sedatives for days or weeks, for fear of this reliving of the experience, until these dreams gradually decreased in frequency and intensity.

Frank anxiety may have been covered up by conversion symptoms or a depressive change in mood. Behind such symptoms there is a fear of the activity in which the person was engaged when the accident occurred, e.g., driving or riding in a car. Psychogenic symptoms, or any symptoms of physical injury, may be used to rationalize the avoidance of the activity which would stir up anxiety.

If unconsciousness occurred from concussion or other injury to the brain or even from syncope, the evaluation of the amnesia and of the subsequent reaction is more difficult but still possible, by attention to the change in personality from before the accident and to the presence or absence of the pathognomonic dreams.

Untreated traumatic neurosis is only one of the factors contributing to an "insurance neurosis" or a "compensation neurosis." Other factors include pre-existing psychoneurotic disorder or personality pattern disturbance, an unresolved grief reaction, when bereavement has occurred in the accident, and the possibility of secondary gain from monetary reward or exemption from stressful responsibilities. Attention solely to the financial and legal aspects of the resultant litigation can obscure the pursuit of the goal which we in the medical profession hold to be important, the return of the patient to as competent and self-respecting a state as is possible.

We all have some wishes to be rewarded for incapacity, whether we recognize these or not, and we all have either resentment of those who are trying to get such rewards or infantilizing sympathies for them. When faced with victims of motor vehicle crash injuries, how can we be prepared to do what is right ourselves and also to make the patients, the attendants and the externals cooperate?

First, all physicians and surgeons should be alert to the early signs and symptoms of a gross stress reaction. If there has been no incapacitating physical injury, the physician or surgeon should insist that the patient return immediately to the activity in which he was frightened. This is the common sense of getting right back on the horse, when one has been thrown, to prevent a phobia for horseback riding. In conditioned reflex terms, it involves extinction of the conditioned fear response when the unconditioned stimulus of an accident is no longer there. If the patient is badly "shaken," the doctor should prescribe sedation for the first few nights after the accident and insist that he talk out his feelings about the accident to family and friends as much as possible, even though this might seem disturbing to him and to others. It can prevent the greater disturbance of a prolonged traumatic neurosis.

If immediate return to activity is precluded by care for the physical injuries, the measures of gradually decreasing sedation and encouragement to talk it out are most important for the prevention of fixation on physical symptoms. During convalescence, failure of the patient to

resume activity in proportion to physical recovery, or persistence of pain or other symptoms not explainable by somatic mechanisms are signals of the probable need for further assessment of psychoneurotic reaction to injury. At this stage, a traumatic neurosis can be cured by the specialized psychiatric technique of abreaction of the feelings about the accident under intravenous barbiturate, followed by firm insistence on return to work or to the activity in which the person was engaged when the accident occurred. At this stage, any aggravation of pre-existing neurotic trends or any unresolved grief reaction can be recognized. At this stage, appropriate social or psychiatric therapy can be much more successful than when the patient is allowed to drift into a chronic compensation neurosis. At this stage, working in a group with others who are recovering from injuries may facilitate the return to self-respecting activity.

The prevention of insurance neuroses and compensation neuroses requires that physicians and surgeons do what is right in not overlooking what is happening to the person who has had the accident.

The attendants and the externals who contribute to the psychiatric complications of automobile accidents include lawyers and legislators who are responsible for insurance and compensation laws and the abuse of these, insofar as they place emphasis on reward for incapacity rather than on treatment and rehabilitation. A review of seventy sources in the literature on "neuroses and compensation" [*13*] came to the conclusion that "there is marked uniformity of opinion among medical authors that compensation for neurosis should be abolished or that changes in the administration of compensation should be brought about." We should persist in trying to make the attendants and the externals cooperate toward making the goal of legal pressures the rehabilitation of the physically or emotionally injured rather than the encouragement of an unhappy parasitic existence. However, as we mention this mote in our brother's eye, we should not forget the beam in our own. We, as physicians and surgeons, can recognize at an earlier stage the need for treating the accident victim as a person whose life has been disturbed and who may need psychiatric consultation, the help of a family agency or the sheltered workshop of a rehabilitation unit to return him to his previous equilibrium, or even to a better one if his problems contributed to the accident.

Patients with injuries to the head and back may particularly need a comprehensive neurological and psychiatric assessment if symptoms are persisting during convalescence. Without repeating in detail a discussion of these problems by one of us (W. D. R.), based on a study at the Montreal Neurological Institute for the Subcommittee on Surgery of the Associate Committee on Medical Research of the National Research Council of Canada [*15*], the following can be stated in summary. A comprehensive physical *and* psychological assessment by some *one* physician or surgeon is needed for the understanding of post-traumatic symptoms referable to the head or back. It is not enough to focus on one organic or psychological finding picked up by a general practitioner, neurosurgeon, orthopedic surgeon or psychiatrist. If the doctor consulted by the patient does not have the time or interest to make a comprehensive assessment of the person and his body, including the emotional sequelae of accidental injury as well as the neurological or orthopedic deficits, he will save time for himself as well as suffering for the patient if he makes a referral to a neurologist, a psychiatrist or a specialist in physical medicine who will look at psyche and soma together.

The coordinated treatment of physical, psychological and social problems produces better results than tackling these one by one in the hope that attention to one problem alone might turn the trick. Perhaps a protruded cervical disc must be removed before the patient can return to the activity which will decrease his emotional tension, but perhaps he must be remotivated to increased activity before his depression will lift completely and the psychic aggravation of his pain fade away. One doctor, looking at the whole picture, is in the best position to decide the sequence of steps in which the patient, the attendants and the externals can cooperate.

SUMMARY AND CONCLUSIONS

In the prevention and treatment of the results of traffic accidents, "the physician must not only be prepared to do what is right himself, but also to make the patient, the attendants and the externals cooperate."

It is the obligation of the automobile manufacturer to provide the safest vehicle possible,

and it is the obligation of all attendants to insist that passengers use these devises.

Persons who are prone to repeated automobile accidents can be screened out during examination for driver license by court and credit records, psychological tests and clinical examinations. A system of division of responsibility is suggested between licensing authorities and private doctors which would protect society and provide opportunity for persons to obtain treatment and surmount the disorders which would preclude them from driving.

It is the obligation of the lawmaker, the insurance carrier and the medical profession to cooperate to insure that the data available in physicians' records are taken into consideration in driver licensure.

Gross stress reaction, or traumatic neurosis, is insufficiently recognized in civilian medical practice. The characteristic features by which it can be diagnosed are described. The early treatment of uncomplicated gross stress reaction is urged. A stage during convalescence from physical injury is suggested as a point at which treatment of traumatic neurosis and of other factors contributing to compensation neurosis can be most effective. We must urge legal attention to treatment and rehabilitation rather than to monetary compensation as well as recognizing, within the medical profession, the importance of the personal life of the person who has suffered the effects of an accident, for example, when dealing with the post-traumatic sequelae of injuries to the head or back.

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Trauma and "Joint Action"

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It is difficult to state authoritatively who first conceived the idea of bringing together for united effort those organizations which are concerned with the problems of trauma, but I believe it was Dr. Charles G. Johnston of Detroit. Dr. Johnston, who played a major role in the formation of the American Association for the Surgery of Trauma, discussed this matter with me a year or more before joint effort was achieved.

Dr. William L. Estes and I discussed it with Dr. Paul Hawley, the director of the American College of Surgeons, and then with the Regents of the American College of Surgeons. The Committee on Trauma of the College has been for years an important part of the College, and was as national in its scope as was the College itself. The Regents gave their endorsement to the proposal for "joint action."

Dr. Hawley discussed the proposal with Maj. Gen. George C. Stewart, the executive vice-president of the National Safety Council, and he indicated serious interest. The first meeting was arranged for October 1957, in Chicago.

The National Safety Council has for some years played the major role in this country in the problems associated with the prevention of accidents on the highways and in industry. The Committee on Trauma of the American College of Surgeons has likewise played a major role in standardizing the care of patients with fractures, and more recently with the problems concerned with the alterations from normal physiological functions which frequently are secondary to trauma in man. The American Association for the Surgery of Trauma has successfully brought together in a single society all those seriously interested in trauma and its problems. From such a "wedding" a great deal of good was bound to come, and it has.

The "Joint Action Committee" meets at the staff level of its component organizations frequently, and once a year the duly accredited representatives of the organizations meet to strengthen the approach to the problems of trauma. The Joint Committee has already achieved some major advances, and will, I am sure, strengthen its framework to the end that the severely injured patient will receive the very finest type of care it is now possible to give. It has set a splendid example for all of us interested in what can be achieved by united effort.

The National Safety Council is still concerned with the prevention of accidents. The American Association for the Surgery of Trauma and the Trauma Committee of the American College of Surgeons have been concerned with the salvage of those injured. The three organizations working together will minimize, we hope, the number of accidents and improve the immediate and later care of those who suffer serious injury following trauma. The effective liason now achieved will keep the organizations concerned with joint action, informed beyond any degree previously conceived. The important thing is that laymen and surgeons can effectively work together for the welfare of mankind.

End of Symposium

Giant Hypertrophic Gastritis

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GIANT hypertrophic gastritis is a clinical entity which taxes the diagnostic acumen of surgeon, radiologist, gastroscopist and pathologist. It has usually been presented in the literature as a rare condition: Feldman [7] found one case in 25,000 gastroscopies; one case was discovered in 8,000 gastric operations at the Mayo Clinic [1]; elsewhere a single case was recorded in 8,000 autopsies [6]. Schindler [15], who presented six cases, argued that this condition is not so rare as depicted. Undoubtedly, the cases encountered by the surgeon far outnumber those reported, as brought out in discussion of a case presented by Patterson [14]. Bartlett and Adams [2] in 1946 cited 208 cases, forty-five of which had pathologic confirmation. The others were diagnosed radiologically and/or gastroscopically. The pitfalls of these methods in this disease are well known. Cases with pathological verification are the ones on which analysis should be based, since diagnosis is otherwise uncertain. In the literature to date such cases number seventy-three. Six additional cases are herein presented, with hopes that a "rare" condition of unknown etiology may be dealt with in more certitude by the surgeon. It is the surgeon who most often is confronted with this entity (in malignancy suspects) at the time of operation and is faced with the decision as to what course to pursue.

CLINICAL FINDINGS

Although most observers state that a recognizable syndrome is not associated with giant hypertrophic gastritis, there does appear to be a general pattern within which symptomatology falls. In the six cases presented herein, two patients had sharp epigastric pains, one had mid-epigastric squeezing pains and one complained of a "beating sensation" in the epigastrium. One had diffuse upper abdominal discomfort for ten years and another presented with gross upper gastrointestinal bleeding in the absence of other symptoms. Two patients obtained relief from antacids.

In an analysis of fifty proved cases, Fieber [8] reported that pain was the cardinal symptom in 74 per cent, weight loss occurred in 60 per cent, vomiting in 42 per cent and hemorrhage in 20 per cent. In some cases the vomiting may be caused by intermittent obstruction due to prolapse of redundant gastric mucosa through the pylorus. This was demonstrated by Eckhoff [5] at operation, in which there was partial intussusception of stomach mucosa into the duodenum.

Benedict [3] found hemorrhage in 40 per cent of these cases and repeatedly emphasized its danger. The patient in Case II of the present report lost more than 4,000 cc. of blood over a ten-day period prior to operation. In the case recently reported by Williams [18], the bleeding was more rapid and massive.

Hypertrophic gastritis has been found in persons at all ages between twenty-nine and seventy-six. Although the present series consists of five men and one woman, there is said not to be a sex differential.

Physical examination is usually unremarkable in these patients, with the exception of occasional epigastric tenderness. Abdominal

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masses have been described rarely. Peripheral edema has occasionally been observed. It was present in one of our cases, and in two cases cited by Maimon [12], in conjunction with hypoproteinemia and in the absence of cardiorenal disease.

LABORATORY FINDINGS

Elsewhere serum protein levels had been found diminished in four of only seven cases in which measurement had been done. Total serum protein determinations were obtained in each of the present six cases and were markedly decreased in one case. Several hypotheses have been advanced for coexisting hypoproteinemia and edema, which include: (1) deficient protein intake secondary to the basic disease; (2) loss of serum proteins from the gastric mucosal surface; and (3) toxic suppression of protein formation or synthesis by some factor produced by the diseased mucosa.

Blood and urine analyses are normal in this condition except in cases of hemorrhage when a secondary anemia is found.

An associated gastric hypoacidity has been reported. In this series, anacidity after histamine stimulation was found in three of six cases. Free acid after histamine was found in one case, and fasting free acid was present in the remaining two cases. Kenney et al. [11] in 1955 reported that anacidity was present in seventeen of thirty cases tested, among forty-five cases of giant hypertrophic gastritis then in the literature.

Microscopic study of the hypertrophic mucosa in this disease does not demonstrate an increase in the number of parietal cells. Cox and Barnes [4] have shown in the rat that the hydrochloric acid secretory capacity is directly related to the number of parietal cells present. Several observers have described "colonic" or "intestinal" metaplasia of stomach glands in which columnar and goblet or Paneth's cells become predominant. They stated that acid secretion diminishes in proportion to such predominance, with consequent lessening of parietal cell activity.

Exfoliative cytologic studies in giant hypertrophic gastritis are seldom discussed in the literature. Fieber states they are not of value, and cites two false positive reports from discussion of the case report by Patterson. In the present series, gastric aspirates were examined (by Papanicolau technic) in the six cases and were labeled either class I or II, without false positive results being reported.

RADIOLOGIC FINDINGS

Fieber [8] cites only two correct radiologic diagnoses in fifty cases of giant hypertrophic gastritis that were established by operation. The markedly distorted rugal pattern usually leads to a radiologic diagnosis of a malignant gastric neoplasm. Lymphosarcoma is often suspected. The correct diagnosis was suggested from roentgenographic study in two patients in the present group but was the primary diagnosis in only one. Gastric neoplasms were considered to be present in the other patients.

Review of the roentgenograms in the six cases reported herein emphasizes the difficulties in differential diagnosis of hypertrophic gastritis. Certain observations were made in this group that might suggest the benign nature of the lesion. The proximal half of the stomach was involved primarily by the hypertrophied rugae in five of the six cases and the entire stomach in one. At the time of fluoroscopic examination the stomach was found to be of medium size, orthotonic, and to possess normal peristaltic activity in four of the patients. Evidence of rigidity or absence of peristalsis was not present in any. This finding contrasted with the roentgenographic finding of filling defects and masses which occupied a significant portion of the stomach. Polypoid tumor masses were described in three, and irregular filling defects were stated to be present in the remaining three. Problems of interpretation may be attributed to the location of the area which was most markedly involved in some instances. In two patients the predominant involvement was of the greater curvature and in two the cardia of the stomach. In only one was the possibility of ulceration suggested.

Study of the radiographic appearance of the stomach has been carried out at intervals in three patients following exploratory laparotomy. Roentgenograms of the upper gastrointestinal tract, obtained four months after operation in the patient who was subjected to partial gastrectomy (Case V), demonstrated a resected stomach with a normal rugal pattern. (Fig. 2B.) In Case II, the rugal pattern of the stomach was found to be unremarkable seven months after exploratory laparotomy and biopsy of the gastric wall.

Radiologic examination was performed in one

patient (Case I) eight years after the diagnosis of giant hypertrophic gastritis was made. The marked hypertrophy of the gastric rugae with apparent filling defects has persisted without apparent change during the period of observation. (Fig. 1D.) This is in contrast to the clinical progress of the patient who has been relatively free of gastrointestinal symptoms.

The diagnosis of giant hypertrophic gastritis may be considered strongly by the radiologist when the folds are found to be continuous and flexible, and rigidity and ulceration are absent. However, the radiologic appearance is often misleading and the margin of the hyperrugosity may appear ragged and irregular as it was in two cases in the present group. The diagnosis of giant hypertrophic gastritis may be strongly suspected when there is an extensive polypoid gastric mucosal defect without ulceration or rigidity of the gastric wall. However, it would appear unlikely that the radiologic appearance of this abnormality can be accepted as sufficiently distinct from neoplastic lesions to establish the clinical diagnosis for therapy.

GASTROSCOPY

Gastroscopy appears to be only slightly more successful as a diagnostic aid than is radiologic examination. In fifty cases pathologically verified, twenty-six had been subjected to gastroscopy, and in only eight was the correct diagnosis made. Various neoplasms were described in the remainder. Gastroscopy was performed in three of the six patients in the present series. Lymphosarcoma was thought to be present in two, and in a third a specific diagnosis was not made, although coarse rugae were described. Benedict and others have repeatedly stated that positive diagnosis is impossible by gastroscopic examination without pathologic study.

ANALYSIS OF SURGICAL TREATMENT

Thus, the majority of patients with this problem come to operation with a presumptive diagnosis of malignant neoplasm and radical surgery is frequently planned. A few, including the patient in Case III, have been subjected to thoracoabdominal exploration. The gross appearance and the sensation by palpation will usually suggest the presence of giant hypertrophic gastritis. The absence of a definite mass and the enlarged folds of mucosa are compatible with this condition. The tactile sensation in giant hypertrophic gastritis has been described in vivid terms, e.g., "bags of worms," "full of sausages," "varicocele" and "bag of night crawlers."

Many authors believe that indications for the surgical treatment of giant hypertrophic gastritis are the same as those for peptic ulcer, e.g., repeated or massive hemorrhage, obstruction, intractable pain or possible malignant change. Bartlett and Adams have advocated total gastrectomy for diffuse involvement. Fieber has advocated partial gastrectomy because unpleasant symptoms and adverse nutritonal effects have followed total gastrectomy.

In the reported cases, total gastrectomy has been performed in thirteen, partial gastrectomy in forty-six, and gastrotomy with or without biopsy in seventeen. These figures include the patients reported herein. In these six patients, partial gastrectomy was utilized in one and gastrotomy in five. In four of the patients who underwent gastrotomy, biopsy specimens of the gastric mucosa were taken. Short term follow-ups on six patients who underwent total gastrectomy have been described as satisfactory. There was one postoperative death, and in one case severe weight loss occurred.

Follow-up data are available in eighteen of the forty-six patients who were treated by partial gastrectomy. Satisfactory results with weight gain occurred in thirteen. There were three operative deaths. The maximum period of observation after operation has been four years.

The five patients in this series in whom gastrotomy only was performed present an opportunity to follow the natural history of the condition. Three patients have cooperated well during the follow-up period, and two (Cases I and II) have been followed up for ten and eleven years, respectively. In Case I, seven gastrointestinal series during this interval have showed little change in rugal pattern. Symptoms have been limited to occasional epigastric discomfort and belching, although before gastrotomy there was sharp pain associated with vomiting. A prescribed gastric diet was followed only sporadically. The patient in Case II has been followed up for eleven years after laparotomy, which was precipitated by hemorrhage. Roentgenographic study of the stomach seven months after operation was reported to be normal. Further bleeding has not occurred. This patient has been faithful to a prescribed

bland gastric diet and has had no other symptoms. Two patients failed to return for observation. The patient in Case VI was asymptomatic one month after laparotomy and biopsy, and was tolerating a six-feeding gastric diet well.

Partial gastrectomy was performed on the patient in Case V. Mild "dumping" symptoms have persisted for two years since operation, but the original complaint of "squeezing" pain in the epigastrium has not recurred. Roentgenograms four months after operation showed a normal rugal pattern in the gastric remnant. The two cases with apparent regression in size of gastric rugae four and seven months after partial gastrectomy and gastrotomy, respectively, corroborate the report of Grime and Whitehead [*10*] in which regression of a hypertrophic rugal pattern was noted fifteen months after partial resection.

PATHOLOGIC FINDINGS

Illustrations from surgical and pathologic specimens in the literature indicate that gastric rugae are thicker, the sulci deeper, and the contour more serpiginous than in the normal stomach. The similarity to cerebral convolutions has been described. The disease may involve either the entire stomach or a portion of the organ. Palmer [*13*] has described four hypertrophic types which were based on structure of the rugae and underlying muscularis mucosa. Mucosal cysts have been described and have been considered caused by edema or hypertrophy of a gland which leads to simple obstruction. "Intestinal metaplasia" is thought important by many observers. Attempts have been made to correlate histologic findings with anacidity and volume of secretion.

The entities of multiple gastric polyposis and giant mucosal hypertrophy merge at times and become coexistent and indistinguishable. Spriggs and Marxer [*16*] have reviewed this condition, "polyadenome polypeux," in contrast to "polyadenome en nappe," or the giant hypertrophic gastritis discussed herein. Both conditions were described well by Menetrier in 1883 [*16*].

The histologic findings in the six cases in the present series have been reviewed.* The mucosa has been found to be thickened and often contained considerable lymphoid tissue. The glandular structure has an orderly appearance and a luxuriant pattern. The glands have been found to be well formed and frequently presented areas of definite hyperplasia. The cells were often hyperchromatic, particularly in the superficial portions, but evidence of metaplasia was absent. The basal layer was intact in each instance. Characteristic sections are illustrated in Figures 1B and 3. Cystic dilatation is a common histologic finding.

Texter and associates [*17*] were able to find only two cases, one their own, of giant hypertrophic gastritis which were associated with invasive adenocarcinoma of the stomach. Fieber noted four such cases. Gillette's [*9*] single case, with extensive submucosal penetration by glands and an omental node containing carcinoma, had a short follow-up, and another primary site could not be ruled out. It would therefore appear that carcinomatous change is a rare complication. Pernicious anemia has not been reported with hypertrophic gastritis.

ETIOLOGY

Consideration of the etiology of this condition has been little more than speculation. There have been few common denominators in the history. Irritants, vitamin and dietary deficiencies, and mechanical and endocrine factors have been suspected. Hypertrophic rugae have been produced in dogs by prolonged administration of histamine and pilocarpine [*4*]. One can also speculate on a possible role of acetozolamide in the production of hypertrophy, in view of its inhibitory effect on gastric acid secretion.

Hypertrophic gastritis as only a part of generalized intestinal disease has been suggested in the presentation of a case in which small bowel series showed extension of mucosal hypertrophy into both small and large bowel [*4*]. In Case 1 reported herein, roentgenograms of the small bowel showed disordered function with dilatation and scattering of barium, suggesting diffuse disease. Radiologic studies of the small bowel should be obtained in cases of giant hypertrophic gastritis to determine if such generalized involvement is indeed common.

CASE REPORTS

CASE 1. J. S. (NYH No. 437337), a thirty-two year old mechanic, complained of knife-like midepigastric pains for three years, coming intermittently between meals or awakening him at night, and relieved by food. Seven months before admission, gastrointestinal roentgenograms in the out-

* We are indebted to Dr. John M. Pearce for his assistance in the review of the microscopic findings.

FIG. 1A. Case 1. Radiologic study of the stomach before exploratory laparotomy and gastric biopsy demonstrated marked hypertrophy of the gastric rugae throughout the stomach. Both the lesser and greater curvatures of the stomach appeared involved and there was an apparent filling defect in the body of the stomach along the greater curvature. The radiologist concluded that giant hypertrophic gastritis was the most likely diagnosis but that lymphosarcoma should be strongly considered.

patient department suggested hypertrophic gastritis. (Fig. 1A.) Gastric analysis yielded 80 units of free acid in a fasting state. An ulcer regimen was begun with some relief obtained; however, nausea with clear vomitus appeared.

Another gastrointestinal series showed progression of the hypertrophic mucosal pattern, and the possibility of lymphosarcoma was suggested. The radiologic impression was supported by gastroscopy and hospitalization was recommended.

On physical examination abdominal masses or peripheral edema were not found. Laboratory data showed that free gastric acid was present; total serum proteins, 6.7 gm. per cent; gastric Papanicolau was class 1. A second gastroscopic examination resulted in the impression of gastric lymphosarcoma. The roentgenographic study was repeated and found unchanged except for the addition of "duodenitis and jejunitis" suggested by scattering and dilatation of barium patterns.

Laparotomy was performed on February 8, 1947. The stomach wall was described as greatly thickened, with no discrete masses palpable. Numerous enlarged greater omental nodes were biopsied. Gastrotomy was performed, and greatly hypertrophied mucosal folds were observed. A full-thickness biopsy specimen was taken and the procedure concluded. The surgical pathologist reported normal lymph nodes and hyperplastic gastric mucosa. (Fig. 1B.)

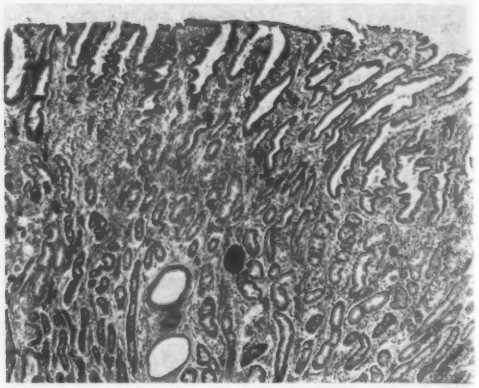

Fig. 1B. Case 1. Low power magnification of gastric mucosa. This section demonstrates the cystic dilatation and increased tortuosity of the gastric glands in a thickened mucosa.

The patient's postoperative course was uncomplicated, and a six-feeding gastric dietary regimen was tolerated with only rare episodes of epigastric discomfort with excessive belching. Seven gastrointestinal roentgenograms during the ensuing eight years showed approximately the same degree of hyperrugosity as had been observed preoperatively. (Fig. 1C.)

Radiologic study of the small bowel on June 1, 1955 (Fig. 1D) showed "disordered function with thickening of folds, residual barium scattering, segmentation and dilatation, but with normal transit time." A hypertrophic mucosal condition involving the whole intestinal tract was suggested by these films.

CASE II. F. W. (NYH No. 468381), a thirty-one year old grocery clerk, who was in previous good health and without gastrointestinal symptoms, noted the onset of hematemesis and melena five days before admission. He fainted on the morning of admission when he had simultaneous tarry stools and hematemesis. A weekly intake of about 7 quarts of beer was noted in the history.

Physical examination revealed a slender, very pale young man. Pulse was 88, blood pressure 105/70 mm. Hg. Other physical findings were unremarkable. Laboratory data showed a hemoglobin of 8.0 gm. per cent; red blood cells, 2.2 mil./cu. mm.; white blood cells, 10.1 thousand; blood urea

FIG. 1C. Case 1. Roentgenogram taken March 27, 1952, approximately five years after gastrotomy and biopsy.

FIG. 1D. Case 1. Roentgenogram taken June 1, 1955, more than eight years after operation demonstrates little change in the appearance of the stomach.

nitrogen, 23 mg. per cent; total serum proteins, 4.6 gm. per cent; A/G ratio, 3.7/0.9. After transfusions, total serum proteins were 6.7 gm. per cent; stool guaiac was 4 plus.

During the two days following admission he received 1,000 cc. of blood without change in the hemogram. A large hematemesis occurred, and during the following four days he was given 2,500 cc. whole blood. At this time the hemoglobin level reached 10.5 gm. per cent and the red blood cell count 2.9 mil./cu. mm.

Roentgenograms revealed a marked irregularity of the greater curvature with several filling defects. The radiologic impression was lymphosarcoma, although hypertrophic gastritis was mentioned as a possibility. Gastroscopy was performed and "a polypoid lesion with sessile protruberance" was reported. The upper half of the stomach felt inelastic and the impression was lymphosarcoma. Gastric washings were reported as class 1 Papanicolau, and 25 units of free acid were found after histamine stimulation.

Operation was performed on February 21, 1947. Exploration revealed a "soft, smooth stomach with no serosal abnormality." Through a gastrotomy, the mucosa was described as "friable, edematous and hemorrhagic, being thrown into large rugae." Biopsy specimens were taken from several areas, one of which was full-thickness. Microscopically, the glands were described as degenerated, but in no areas malignant. There was hemorrhage throughout the entire thickness of the stomach wall. The diagnosis was "combined acute and subacute gastritis."

Gastric roentgenograms on September 16, 1947, demonstrated the stomach to be flexible and freely mobile without filling defects. The impression was that of a normal stomach. The patient has been well for eleven years without recurrence of bleeding, and has been faithful to the prescribed bland gastric diet.

CASE III. W. R. (NYH No. 646960), a fifty-six year old laborer, complained of lifelong indigestion, which ten years ago became more frequent and persistent but still responsive to antacids. Intermittent swelling of the ankles, had occurred for three years, and anorexia began three months prior to admission. Upper gastrointestinal x-rays taken elsewhere showed a large mass in the cardia, suggestive of carcinoma. Subsequent roentgenograms showed "growth of the mass," and the patient was admitted to the New York Hospital. Alcohol ingestion, limited to beer, had been moderate over the years.

On physical examination one observer felt an ill-defined mass in the left upper quadrant of the abdomen. There was 1 plus pitting edema of the ankles. Blood count and urinalysis were normal. Total proteins were 6.4 gm. per cent with an A/G ratio of 4.4/2.0 gm. per cent. Gastric analysis did not yield free acid after histamine stimulation. Stools were all guaiac-negative. Gastric chymotrypsin studies produced class II Papanicolau cells. Roentgenograms of the upper gastrointestinal tract showed a "tumor mass 5 cm. in diameter growing into the stomach at the cardia." The

FIG. 2A. Case v. There is a marked distortion of the mucosal pattern with polypoid changes in the upper half of the greater curvature according to the radiologic interpretation prior to operation.

FIG. 2B. Case v. Four months after partial gastrectomy and gastroduodenostomy, roentgenogram shows a resected stomach with normal rugal pattern.

radiologic impression was carcinoma at the cardia. Gastroscopic examination did not confirm a discrete mass: "coarse rugae but no lesion" were visualized.

On February 6, 1953, operation was performed using a thoracoabdominal incision. The fundus of the stomach was described as feeling like a "bag of worms." Hugely hypertrophic rugae were observed through a gastrotomy in the middle third of the stomach. A biopsy specimen was taken and the operation terminated. The pathologic diagnosis was hypertrophic gastritis. The patient was lost to follow-up after two months.

CASE IV. H. D. (NYH No. 184366), a forty-nine year old porter, had his first attack of severe epigastric pain five months prior to admission, a sharp pain radiating through to the back, lasting for five minutes. This recurred at irregular intervals without relation to food intake or time. There was no weight loss, melena, or history of alcoholism or chronic medications. When first seen in the outpatient department, upper gastrointestinal roentgenograms showed a large filling defect in the cardia and fundus suggestive of foreign body or polypoid neoplasm. The patient was admitted for further study.

Physical examination was non-contributory. Hemogram and urinalysis were normal, and stools were repeatedly guaiac-negative. Gastric balloon washings were class II Papanicolau. Repeat gastrointestinal x-rays showed a large filling defect "probably representing malignancy." Free acid was present in the fasting gastric specimen.

Because the admission electrocardiogram showed that a recent coronary occlusion had occurred, the patient was kept on bedrest for four weeks followed by frequent electrocardiograms, after which interval operation was felt justified. On June 20, 1955, laparotomy was performed, and "thickening with hyperrugosity" was described about the fundus, confirmed by gastrotomy; no biopsy specimen was taken.

The patient's postoperative course was uneventful, and gastrointestinal x-rays one month following operation showed no appreciable change from the preoperative films. The patient was followed up for one year, and although he had returned to work he complained of the same symptoms experienced before operation. He did not adhere to a prescribed gastric dietary regimen.

CASE V. R. O. (NYH No. 735955), a thirty-nine year old housewife, complained of an epigastric "squeezing pain" which moved about the upper abdomen and began after eating fruits or fats. The pain was not relieved by antacids. There had been a 20 pound weight loss over the preceding two years.

At physical examination two examiners felt a soft epigastric mass. There was no peripheral edema. Blood count and urinalysis were normal. Gastric analysis showed no free acid after histamine stimulation. The total proteins were 6.8 gm. per cent with an A/G ratio of 4.8/2.0. Stools were guaiac-negative, and intravenous pyelogram, x-rays

of the gallbladder and electrocardiogram were normal. (Fig. 2A.)

Laparotomy was performed on May 17, 1956. The stomach wall was described as feeling thickened, with a redundant mucosa sliding freely beneath it. Subtotal gastrectomy and Billroth 1 anastamosis were performed. The pathologic specimen consisted of 140 gm. of stomach, the mucosa of which was heaped up into very large hypertrophied rugae. Histologically the mucosa was extremely thick and contained much lymphoid tissue.

The patient did well clinically in the immediate postoperative period, although roentgenograms nine days postoperatively showed a two-hour delay in barium passing the anastomosis. Following discharge from the hospital epigastric distress developed postprandially, with palpitations, sweating and weakness. She was placed on a low carbohydrate, high protein diet, and proceeded to gain weight with decrease in symptoms. Upper gastrointestinal roentgenograms on September 10, 1956, showed a "normal rugal pattern with a normally functioning anastomosis." (Fig. 2B.)

CASE VI. J. B. (NYH No. 470080), a fifty-two year old white man, was admitted to the hospital with complaints of anorexia and "indigestion" of approximately six years' duration. His pain was not severe, seemed to be increased by the ingestion of food and did not resemble peptic ulcer distress. He reported a 12 pound weight loss in the six weeks before hospitalization. Mild nausea had been experienced for four weeks. His consumption of alcoholic beverages had been heavy for many years.

His past history included excision of a bronchiectatic cyst of the right lower lobe of the lung in 1947 and an inguinal hernioplasty one month before admission.

Physical examination on admission revealed mild epigastric tenderness but other findings were unremarkable.

Urinalysis was negative. Hemoglobin was 16 gm. per cent; hematocrit, 51; gastric cytology, class 1; serology, negative. Gastric analysis showed no fasting free acid, and acid was not found after histamine injection. Liver function tests showed that bilirubin, phosphorus and alkaline phosphatase levels were within normal limits; thymol turbidity, 3 units; cephalin flocculation, 6 units; bromsulfalein retention, 23 per cent. Total protein was 6.5 gm. per cent with 4.7 gm. per cent albumin. Three stool specimens did not contain occult blood.

Roentgenograms of the stomach demonstrated a defect of the fundus of the stomach which was interpreted as carcinoma. Barium enema was negative for abnormalities.

Exploratory laparotomy was performed on October 11, 1958. The stomach and duodenum as well as the remainder of the gastrointestinal tract appeared normal. There was some thickening of the fundus of the stomach. Gastrotomy was performed and the gastric mucosa was found to be thickened with exaggerated rugal folds in the mid-third of the stomach. Ulceration was not present. A generous biopsy specimen was obtained, and the stomach closed. The surgical pathologist reported hypertrophy of the gastric mucosa. (Fig. 3.) The patient was discharged eleven days after operation.

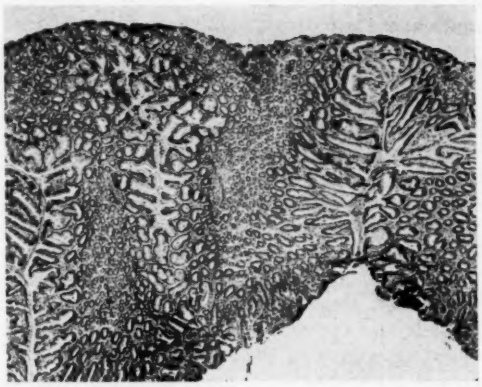

FIG. 3. Case VI. Low power magnification of gastric mucosa. The branching of the gastric glands appears exaggerated. The cells which line the crypts are columnar and orderly in arrangement.

COMMENTS

The syndrome of giant hypertrophic gastritis has evolved gradually over the years since Menetrier's original discussion seventy-five years ago. It presents a clinical picture sometimes similar to peptic ulcer, yet is often asymptomatic or very mild, and draws attention because of the striking x-ray findings. Bleeding as a complication in this condition is more frequent than either obstruction or malignancy, but less frequent than pain or vague discomfort. The diagnostic pitfalls have been discussed. The clinical and laboratory studies usually result in a diagnosis of a malignant gastric neoplasm. Perhaps more reliance should be placed on cytologic studies. Had they been given more weight in this series, gastric rugal hypertrophy might at least have been considered in the differential diagnosis. However, gastric biopsy is needed to establish the correct pathologic condition.

Results in conservative treatment of this condition have been well reviewed by Fieber [8]. Dietary and vitamin therapy, antacids and

anticholinergic drugs, abstinence from tobacco and alcohol, and administration of dilute HCl have been tried in a few cases, but the results have usually been unsatisfactory. Radiation has been tried in a few cases without benefit of pathologic study. Maimon reports improvement, as evaluated by gastroscopy, in one case following roentgen therapy.

Laparotomy and biopsy are indicated when gastric cancer is suspected, because other diagnostic methods are inadequate. Surgical therapy must depend on many factors, which include the operative risk, dangers of further bleeding, extent of the lesion and suspicion of future malignancy. In most instances partial gastrectomy seems to yield the most satisfactory results. However, the marked improvement in two of the patients in the present series suggests that some selection must be made. Resection is recommended for those in whom obstruction or bleeding has occurred. However, for those in whom operation is undertaken upon suspicion of gastric neoplasm and in whom symptoms are not severe, biopsy for diagnostic confirmation is probably sufficient. Additional study of the course of long term survivors is needed.

SUMMARY

1. Six cases of giant hypertrophic gastritis are reported. One case with massive bleeding is described, and this frequent complication is emphasized.

2. Review of the literature indicates that this condition is not so rare as is frequently stated.

3. The etiology is obscure and diagnostic methods usually lead to suspicion of gastric cancer.

4. The results of treatment have varied. Partial gastrectomy is recommended for those patients with hemorrhage or obstruction, but does not appear to be necessary in uncomplicated cases.

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Results Following Conservative Treatment of Fractures of the Tibial Shaft

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THE following paper is an analysis of the results that have been obtained in fifty-five cases of acute fracture of the tibial shaft in hospitalized patients treated at the University of Kansas Medical Center from January 1950 through December 1957. It represents as nearly consecutive a series as possible, within the limitations of availability of records and adequacy of follow-up.

For the most part the patients included are those who were more severely injured or who had unstable fractures; stable fractures of the tibial shaft are usually managed by immobilization in a long leg plaster and the patients are not admitted to the hospital. The series included nine fractures in children, eight closed and one open. There were seventeen open fractures and twenty-nine closed fractures in adults. The over-all incidence of open fractures was 33 per cent. There were associated fractures of the fibula recorded in 67 per cent of the children and 83 per cent of the adults.

Skeletal traction was used in the initial stage of treatment in 58 per cent of the cases included in this series. In all of these cases a Steinmann pin was drilled through the os calcis for application of the traction, and the extremities were all supported on Böhler frames. No infections of the tracts made by the pins were encountered.

A brace was used at some stage of ambulation in thirty of the adults and one of the children. The usual brace (Fig. 1) was a tibial tuberosity weight-bearing brace with two side irons rigidly attached to the shoe and a leather lacer fracture cuff. Exceptionally, an ankle joint was included, usually for fractures in the distal extremity of the tibial shaft.

FRACTURES OF THE TIBIAL SHAFT IN CHILDREN

For the purposes of this study, girls up to the age of fourteen years and boys up to the age of sixteen years were considered children. The youngest child in this series was eighteen months old, the oldest thirteen years of age. Uniformly satisfactory results were obtained by conservative methods. (Table I.)

Skeletal traction was maintained for nineteen days in one patient treated in this manner and seventeen days in the other. One of the two

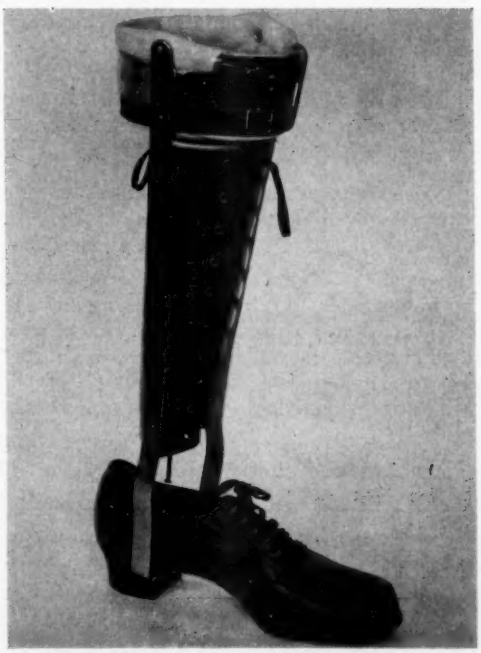

FIG. 1. Tibial tuberosity weight-bearing brace used for fractures of the tibial shaft.

TABLE I
METHOD OF TREATMENT OF FRACTURES OF THE TIBIAL SHAFT IN CHILDREN*

Treatment	No. of Patients
Long leg plaster	7
Initial skeletal traction, followed by long leg plaster	2

* Eight closed fractures, one open fracture.

fractures treated in skeletal traction was allowed unsupported weight-bearing at thirteen weeks, the other was lost to follow-up after full weight-bearing in a brace had been permitted at thirteen weeks. Closed fractures treated initially in a long leg plaster were allowed full weight-bearing at an average time of eleven weeks. It is thought that these figures are not precisely comparable because the more comminuted, unstable fractures were treated by skeletal traction.

The one open fracture was débrided and closed elsewhere. The wound had healed primarily by the time of referral. At the University of Kansas Medical Center angulation was corrected by means of manipulation and application of a long leg plaster.

The over-all average hospital stay for the children was fourteen days. There were no complications and no significant associated injuries.

CLOSED FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Of the twenty-nine closed fractures of the tibial shaft in adults, twenty-four were followed up to unsupported full weight-bearing and five to full weight-bearing in a brace. Braces were used in twenty cases. The average hospital stay was twenty-four days.

The one open reduction was performed on an

TABLE II
TREATMENT OF CLOSED FRACTURES OF THE TIBIAL SHAFT IN ADULTS (29 CASES)

Treatment	No. of Patients
Manipulation, long leg plaster	7
Skeletal traction	21
Open reduction, fixation with two screws, long leg plaster	1

TABLE III
COMPLICATIONS FOLLOWING CLOSED FRACTURES OF THE TIBIAL SHAFT IN ADULTS (29 CASES)

Complication	No. of Cases	Per cent of Total Cases
Delayed union	0	0
Non-union	0	0
Vascular impairment, leading to gangrene	1	4 (consider 28 cases only)
Peroneal nerve palsy	1	4 (consider 28 cases only)
Infection	0	0
Death due to concomitant injury (first day)	1	3

oblique fracture at the junction of the middle and lower thirds of the tibial shaft in a patient who had had a fracture in this same area twenty-two months previously. (Table II.)

Complications of closed fractures of the tibial shaft in adults are recorded in Table III. For the purpose of this paper delayed union is defined as insufficient healing to allow full weight-bearing without a plaster dressing, either with or without a brace, by twenty-six weeks but with eventual healing of the fracture without bone graft. A diagnosis of non-union was made when the clinician thought the fracture would not heal without a bone graft, the diagnosis being based on both clinical and x-ray evidence.

Vascular impairment leading to gangrene occurred in an eighteen year old Negro male athlete. The patient was referred to the University of Kansas Medical Center five days following the injury which consisted of closed fractures at the junction of the middle and lower thirds of the tibia and fibula. Initial treatment had consisted of manipulation and immobilization in a long leg plaster. Excessive pain was encountered and the plaster was split several times. On the third day the anterior half of the plaster was removed, and the leg was noted to be anesthetic and paralyzed. A heat cradle was then used and the leg became blistered. Progressive gangrene occurred following referral to the Medical Center, and a disarticulation of the knee was performed twenty-four days following the initial injury.

Peroneal nerve palsy occurred in one patient as the result of poor positioning of an extremity that had been immobilized in a long leg plaster. This patient suffered pelvic fractures and a

TABLE IV
INITIAL TREATMENT OF OPEN FRACTURES OF THE TIBIAL SHAFT IN ADULTS (17 CASES)

Treatment	No. of Cases	Complications (No. of Cases)			
		Infection	Delayed Union	Non-union	Amputations
Surgical cleansing, wound dressing (no closure), skeletal traction	1	0	0	0	0
Débridement and immediate closure, skeletal traction	7	4 (57%)	1 (14%)	0	1 (14%)
Débridement and delayed closure (5 days), skeletal traction	1	1 (100%)	1 (100%)	0	0
Débridement, immediate closure, long leg plaster	6	2 (33%)	2 (33%)	1 (17%)	1 (17%)
Débridement, immediate internal fixation with screws or plate, and closure	2	2 (100%)	2 (100%)	2 (100%)	1 (50%)

complete rupture of the small intestine (ileum) as concomitant injuries.

OPEN FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Seventeen open fractures of the tibial shaft were treated in this series. The average hospital stay was twenty-seven days. Table IV records the immediate treatment and complications incurred.

Complications of the open fractures of the tibial shaft in adults as a group are recorded in Table V.

Further breakdown of the infections indicates that in all the patients with primary mild infections the fractures eventually healed (one with delayed union). A primary severe infection in one patient resulted in amputation; one patient (without union of the fracture) committed suicide, and in one the fracture healed. In two of the patients with infection following bone graft, amputation was necessary; in the third, the fracture healed but there is still slight drainage.

Analysis of the five cases of delayed and non-union discloses that one of the patients had defects of the soft tissue requiring skin graft for closure and one had infection of the primary wound. Two of these patients were treated by skeletal traction, two in long leg plasters, and one with initial fixation with plate and screws. Two patients were eliminated from the tabulation on per cent of delayed union and non-union, one because of early amputation and the other because of suicide.

Reconstructive procedures in the form of skin grafts or bone grafts were often unsuccessful. These results are tabulated in Table VI. Of the three skin grafts, two were cross-leg flaps and one a local rotation flap. Two of the bone grafts were of bone bank tibia with cancellous chips; the other grafting was performed at another hospital and the type of graft is not known.

Sixteen cases of open fracture in adults can be considered as to eventual result, one of the original patients being eliminated because of suicide. The fractures eventually healed in thirteen of these sixteen (81 per cent) patients. The average hospital stay for adults with open fractures of the tibial shaft was twenty-eight days.

TABLE V
COMPLICATIONS FOLLOWING OPEN FRACTURES OF THE TIBIAL SHAFT IN ADULTS (17 CASES)

Complications	No. of Cases	Per cent of Total Cases
Coverage defect requiring skin graft for closure	3	18
Delayed union	2	13 (consider 15 cases only)
Non-union	3	20 (consider 15 cases only)
Infection (9 cases)		
Primary, mild	3	18 } 54
Primary, severe	3	18 }
Following bone graft	3	18 }
Amputations	3	18

TABLE VI

COMPLICATIONS FOLLOWING RECONSTRUCTIVE OPERATIVE PROCEDURES ON OPEN FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Procedure	No. of Cases	Complications (No. of Cases)				Eventually Healed Fracture (No. of Cases)
		Late Infections	Delayed Union	Non-union	Amputation	
Skin graft	3	3 (100%)	2 (67%)	1 (33%)	1 (33%)	1 (33%)
Bone graft	3	3 (100%)	3 (100%)	2 (67%)	2 (67%)	1 (33%)

TABLE VII

INJURIES TO THE SAME EXTREMITY OR PELVIS ASSOCIATED WITH FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Injury	No. of Cases
Fracture of pubis	1
Avulsion of anterior superior iliac spine	1
Dislocation of hip with fracture of acetabulum	1
Fracture of acetabulum and femoral neck	1
Intertrochanteric fracture of femur	1
Closed fracture of midshaft of femur	2
Open fracture of midshaft of femur	1
Supracondylar fracture of femur	1
Trimalleolar fracture of ankle	1
Fracture of posterior articular lip of distal tibia	1

INJURIES TO THE SAME EXTREMITY OR THE PELVIS ASSOCIATED WITH FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Significant associated injuries to the same extremity or the pelvis were encountered in eleven of forty-six fractures of the tibial shaft in adults (24 per cent). These injuries are recorded in Table VII. No open operation was performed on any of these injuries, with the exception of débridement and closure of the open fracture of the femoral shaft.

COMMENTS

Closed methods in the treatment of fractures of the tibial shaft in children have been safe and reliable in this small series. There were not enough cases to draw definite conclusions, but our results were in agreement with those published by Wade and Campbell [1] using cast methods alone.

Closed treatment of closed fractures of the tibial shaft in adults has given satisfactory results. Böhler [2] reports an incidence of non-union of 0.2 per cent in a series of 1,130 fresh closed fractures of the tibial shaft, 1,048 of these treated without osteosynthesis. Reduction of days in the hospital is an argument commonly cited for operative methods of treatment. The average hospital stay for patients with closed fractures of the tibial shaft (adults) in this series was twenty-three days, all but one of the fractures being treated by closed methods. Lottes, Hill and Key [3] report an average hospital stay of 1.2 months for simple fractures of the tibia treated with an intramedullary nail.

The results obtained in open fractures of the tibial shaft in adults have been far less satisfactory. The severity of the initial injury, as indicated by the necessity for closure with a pedicle graft, and infection of the primary wound have been associated with a high incidence of non-union and amputation. Ellis [4] has recently reported the severity of injury to be an important determinant of speed of union and incidence of delayed and non-union in fractures of the tibial shaft.

CONCLUSIONS

1. Closed treatment of closed fractures of the tibial shaft in adults has been safe, economical and reliable in a small series of cases.
2. Complications are far more numerous in open than closed fractures of the tibial shaft.
3. Salvage procedures in the form of pedicle skin grafts and bone grafts from bone banks were often unsuccessful.
4. Significant associated injuries of the same extremity or the pelvis have been encountered in nearly one-fourth of the adult cases.

5. The use of an inexpensive brace has contributed to the patient's comfort and early rehabilitation.

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TABLE VI

COMPLICATIONS FOLLOWING RECONSTRUCTIVE OPERATIVE PROCEDURES ON OPEN FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Procedure	No. of Cases	Complications (No. of Cases)				Eventually Healed Fracture (No. of Cases)
		Late Infections	Delayed Union	Non-union	Amputation	
Skin graft	3	3 (100%)	2 (67%)	1 (33%)	1 (33%)	1 (33%)
Bone graft	3	3 (100%)	3 (100%)	2 (67%)	2 (67%)	1 (33%)

TABLE VII

INJURIES TO THE SAME EXTREMITY OR PELVIS ASSOCIATED WITH FRACTURES OF THE TIBIAL SHAFT IN ADULTS

Injury	No. of Cases
Fracture of pubis	1
Avulsion of anterior superior iliac spine	1
Dislocation of hip with fracture of acetabulum	1
Fracture of acetabulum and femoral neck	1
Intertrochanteric fracture of femur	1
Closed fracture of midshaft of femur	2
Open fracture of midshaft of femur	1
Supracondylar fracture of femur	1
Trimalleolar fracture of ankle	1
Fracture of posterior articular lip of distal tibia	1

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1. Closed treatment of closed fractures of the tibial shaft in adults has been safe, economical and reliable in a small series of cases.

2. Complications are far more numerous in open than closed fractures of the tibial shaft.

3. Salvage procedures in the form of pedicle skin grafts and bone grafts from bone banks were often unsuccessful.

4. Significant associated injuries of the same extremity or the pelvis have been encountered in nearly one-fourth of the adult cases.

5. The use of an inexpensive brace has contributed to the patient's comfort and early rehabilitation.

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Benign Cecal Lesions Associated with Appendicitis

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THE purpose of this paper is to report three cases of cecal abnormalities associated with appendicitis, either initially or postoperatively, which were treated at this hospital. The first was a cecal defect detected by roentgenographic study which proved to be chronic granulomatous appendicitis, and was treated by appendectomy. The second patient had intermittent pain in the right lower quadrant on exertion, and roentgenographic evidence of a cecal band-like defect following appendectomy; he was treated by lysis of the adhesive bands with relief of symptoms. In the third case, the patient was asymptomatic and was found to have a palpable mass in the right lower quadrant seven years after appendectomy, with roentgenographic evidence of a filling defect; he was treated by resection of the right colon.

Wilson et al. [10] reported twenty cases of granulomatous lesions of the cecum resembling neoplasms, with a complete review of the literature. Of these, seventeen were the result of chronic appendicitis with periappendiceal inflammation. The incidence of cecal abnormalities after appendectomy has been reported to be a rather common roentgenographic finding [2,3] since first being reported by Artner [1] in 1929. He stated that approximately one-third of the inverted appendiceal stumps persisted and 8 per cent could be visualized as "ring-shadow" cecal defects. The ring shadow is a smooth, circular, cecal abnormality on the inferior medial border and does not involve the mucosal surface. In addition, a nipple-like defect has been described for the non-inverted stump [3]. Also, radiologic examinations showing defects compatible with adhesive bands have been reported following appendectomy [7,8].

In contrast to the stated frequency of these abnormalities associated with appendicitis or appendectomy is the rare appearance of such cases in the literature. In addition to Wilson's review, fifteen cases of this defect were identified as ring shadows by barium enema. Of these, eleven were indistinguishable from polypoid neoplastic lesions, and exploration was necessary to establish the diagnosis [5,8,9,11]. Four cases reported were diagnosed and followed-up by x-ray examination in patients after appendectomy. The three cases in Wilson's report were the only ones of a mass in the right lower quadrant and x-ray evidence of a cecal mass in the postappendectomy group.

The pathogenesis of granulomatous appendicitis, excluding extension of regional enteritis, tuberculosis, actinomycosis, and localized diverticulitis, is usually a walled-off perforation of the appendix. This was definite in ten of seventeen, and probable in an additional three of Wilson's cases. Also, in the same series, in thirteen of fifteen cases the appendix was either retrocecal, retroileal or curled up in the ileocolic angle. In Case I of this report the appendix was along the anterolateral cecal wall, curled upon itself and not perforated. Microscopically the mass showed varying degrees of acute and chronic inflammation. The greater bulk of the tumor was made up of dense fibrous tissue with scattered patches of lymphocytes, monocytes, plasma cells and eosinophils. The granulomatous changes may involve the muscularis and submucosa.

The lesions of the inverted stump usually consist of mucosal hypertrophy overlying the stump and formation of small polypoids. The regional lymph nodes are not enlarged. However, in three of Wilson's cases (including the instance of stitch granuloma) and in one of ours (Case III), adenopathy was present.

Microscopically, acute and chronic inflammatory changes are present with focal foreign body granulomas about the silk sutures. The mucosal surface shows simple hyperplasia. The lymph nodes when involved show only chronic inflammatory changes.

In the formation of adhesive bands no etiologic agent is specific. In Case II the band passed from the appendiceal base to the internal orifice of the internal inguinal ring.

The abnormalities of the cecum which follow appendectomy are essentially benign and are seldom symptomatic. The problem is that of differential diagnosis. In the typical case of cancer of the cecum there is unexplained anemia with a cecal defect demonstrated by x-ray examination, with or without a palpable mass. The x-ray films reveal a rather characteristic deformity in which the mucosal surface is primarily involved. This must be differentiated from the polypoid lesion of the inverted stump. At exploration, inspection of the mucosal surface will reveal a primary mucosal lesion when it is malignant.

The benign lesions producing cecal abnormalities may be classified as either infectious or foreign body reactions. The latter are usually secondary to previous surgical intervention. Of the infectious lesions, diverticulitis, with adjacent walled-off perforations or pericecitis, is increasing in frequency. Here the signs and symptoms are usually those of appendicitis with a protracted course and without appreciable nausea and vomiting. The disease is frequently found, during surgery for appendicitis, as a mass not involving the mucosal surface. When encountered in the cecum at the time of appendectomy, the colon should be opened if any doubt exists about the diagnosis; if it is that of diverticulitis, the overlying mucosa is normal in contrast to that of a carcinoma which involves the mucosa.

Of the non-inflammatory lesions, talc and stitch granulomas may be encountered. In this category would be found the inverted stump of the appendix. It is of interest that only one previous case of a stitch granuloma of the appendiceal stump, associated with a mass in the right lower quadrant, has been reported. Treatment was similar to that in Case III.

CASE REPORTS

CASE I. J. E.T. (H. R. No. 290859), a nineteen year old sailor, was admitted with a history of constipation on the preceding day, and fleeting periumbilical pain the night before admission, followed by nausea and vomiting. The vomitus became bile-stained and contained flecks of blood. Following the onset of vomiting, the periumbilical pain was not noticeable. Past history and review of systems were non-contributory, except for an episode of abdominal pain high in the epigastrium and right upper quadrant, without nausea or vomiting, approximately one month prior to admission, and a "cold" for three days previously. Physical examination revealed no abnormalities except for a temperature of 99.4°F. and slight nasal mucosal hypertrophy.

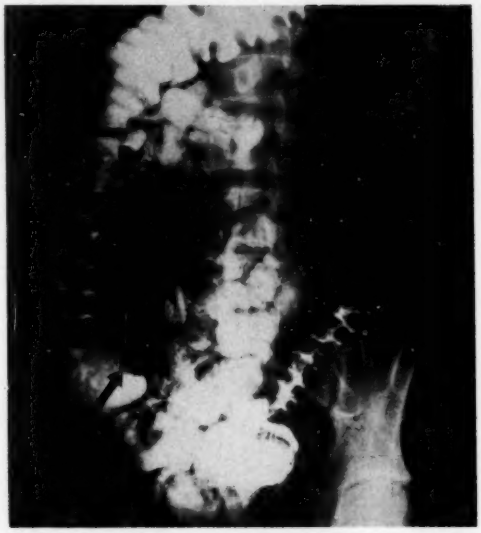

FIG. 1. Case I. Roentgenogram showing the cecal defect produced by enlargement of the lymph nodes and a periappendiceal abscess.

Accessory clinical findings on admission disclosed a white blood cell count of 16,500 per cu. mm. with a normal differential, hemoglobin and hematocrit. The following day the white blood cell count was 12,400 and 15,000 per cu. mm. with no change in the differential; on the fourth day it was 10,500 per cu. mm. A gastrointestinal series was negative for abnormalities. A barium enema disclosed a defect on the medial cecal wall which was interpreted to be of extrinsic origin. This finding was constant on a second barium enema. (Fig. 1.)

During his second night in the hospital, after the evening meal, the patient noted the onset of periumbilical pain which became progressively more intense. Physical examination revealed some tenderness to palpation in the right lower quadrant and mid-epigastric area. These symptoms subsided by the following morning. About one week after ad-

FIG. 2. Case II. Roentgenogram demonstrating the cecal defect produced by an adhesive band running from the base of the appendix to the internal inguinal ring.

mission the patient became anorectic and constipated. These symptoms were relieved with an enema and he remained asymptomatic. A barium enema was given at this time and the cecal defect noted. Following this, a small mass in the right

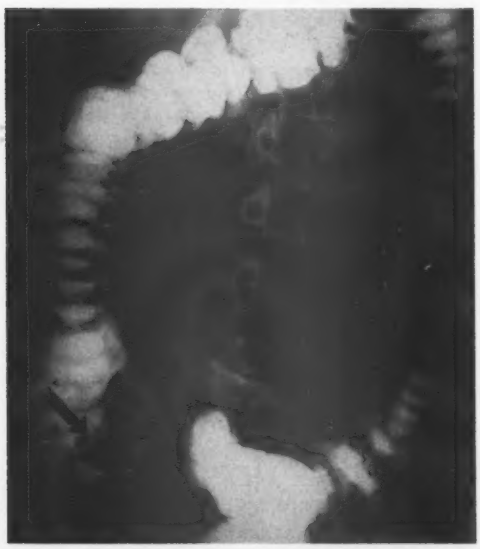

FIG. 4. Case III. Roentgenogram revealing the cecal defect produced by a polypoid lesion at the appendiceal stump.

FIG. 3. Case II. The band running from the appendiceal stump to the internal inguinal ring is demonstrated.

lower quadrant was noted, with mild tenderness to palpation. Another barium enema was given and the mass was still noted.

The patient was transferred to the Surgical Service. Under spinal anesthesia, appendectomy was performed through a right lower paramedian incision. The appendix was lying on the anterolateral wall of the cecum and was coiled upon itself. The ileocolic nodes were multiple and succulent. The nodes were in the area of the cecal defect noted at x-ray examination. The postoperative course was uneventful and the patient was discharged to duty.

CASE II. G. M. S. (H. R. No. 289483), an eighteen year old Marine, was admitted with a history of intermittent, fleeting pain in the right lower quadrant of six months' duration, associated with physical exertion. Initially, the pain occurred every other day or so, but two weeks prior to admission it occurred two or three times a day. There was no nausea or change in bowel habits. Past history and systemic review were non-contributory, except for an incidental appendectomy at the time of repair of a right inguinal hernia at six years of age. Physical examination revealed no abnormalities except for a well healed, right inguinal incision.

Laboratory findings, including urinalysis, complete blood count, x-ray films of the chest and gastrointestinal series, were normal. Barium enema showed a persistent distal cecal constricting deformity. (Fig. 2.)

The patient was explored and a firm adhesive band was found running from the base of the appendix along the iliac vessels to the internal

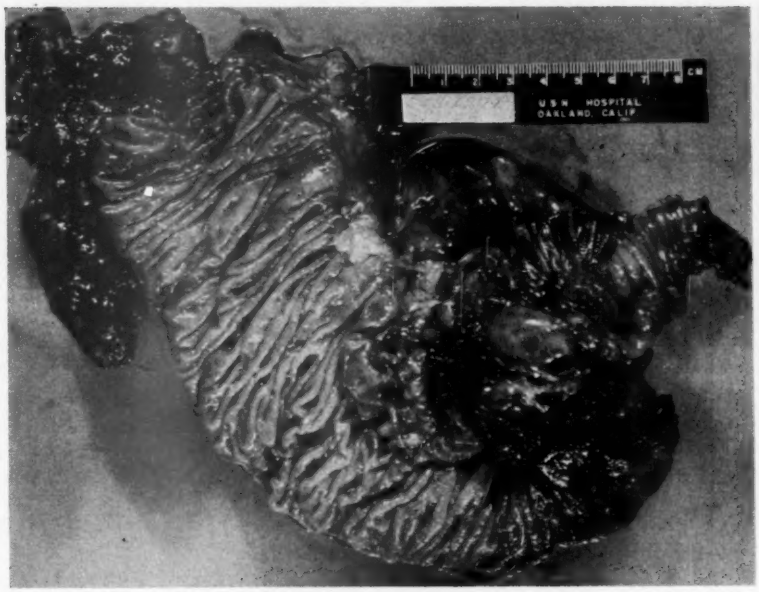

FIG. 5. Case III. Gross specimen showing the polypoid lesion at the base of the appendix.

inguinal ring. (Fig. 3.) The adhesion was divided. The postoperative course was uneventful and he was discharged to duty asymptomatic.

CASE III. D. E. L. (H. R. No. 289625), a twenty-nine year old Marine, was admitted to the Eye, Ear, Nose and Throat Service for tonsillectomy. Past history and systemic review were noncontributory, except for frequent episodes of sore throat, and appendectomy seven years previously. Physical examination revealed no abnormalities with the exception of chronically enlarged tonsils, a 3 by 5 cm. mass, non-tender, mobile and firm, in the right lower quadrant, and a well healed McBurney incision.

Laboratory findings, including urinalysis, complete blood count and x-ray films of the chest, were normal. One of two stool specimens was positive for occult blood. Barium enema revealed a filling defect on the inferior medial quadrant of the cecum, which was thought to be of extrinsic origin. (Fig. 4.)

The patient was explored and upon opening the cecum through an anterior taenia, a 1 cm. polypoid lesion was noted in the inferior medial portion. (Fig. 5.) An area of 2 cm. surrounding this lesion was firm and indurated. Lymph nodes in the ileocecal area were enlarged and firm. Resection of the ascending colon was performed. The specimen obtained by frozen section of the excised lesion was examined but a definite diagnosis could not be made by the pathologist. In the permanent sections, three silk sutures were noted under the area of mucosal hyperplasia. The pathologic diagnosis was acute and chronic granulomatous cecitis, probably due to silk sutures embedded in the cecal wall. The operative report of the appendectomy (1951) stated that the appendix had been acutely inflamed and the stump ligated and inverted with No. 00 silk sutures.

SUMMARY

Three types of radiologic evidence of abnormalities of the cecum may be noted following appendectomy: (1) the ring-shadow of the inverted appendiceal stump, (2) the nipple-like defect of the non-inverted appendiceal stump and (3) defects associated with adhesions. However, polypoid lesions of the cecum cannot be differentiated from the ring-shadow of the inverted stump in all cases. If the diagnosis is not certain, exploration and biopsy should be performed. If lymphadenopathy is present and the diagnosis is in doubt, resection of the ascending colon is probably the safest procedure. The nipple-like defect should not be confused with any other lesion. If symptoms are associated with lesions compatible with adhesions, the latter should be freed.

Three cases are presented: one of granulomatous appendicitis treated by appendectomy;

the second of adhesions from the internal inguinal ring to the appendiceal base, treated by lysis of the adhesions; and the third, a silk stitch granuloma of the appendiceal stump, associated with a palpable mass and regional adenopathy, and treated by resection of the ascending colon.

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Sterilization of the Bowel in Infants and Children

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PREPARATION of the colon in adults about to undergo surgery has been fully discussed by many authors. Very little has been written about preparation of the colon in children. We have chosen a regimen that is simple and apparently effective in infants and children: the combination of mechanical cleansing plus oral neomycin.*

Mechanical cleansing in the form of colonic irrigation is started three or four days before surgery. The irrigating fluid is always normal saline solution and the total amount used varies from 1,000 to 6,000 cc., depending on the size of the child and the amount of fecal material stored in the colon. Irrigation is done twice daily and usually by the resident staff. The rules of procedure laid out for nurses when giving enemas to children are so protective that their attempts are futile when dealing with impactions. Removal of fecal bulk and associated fecal impactions is essential. No operation should be considered until all impactions have been removed since it is impossible to sterilize the bowel in the presence of these concretions.

Administration of oral neomycin is started thirty-six to forty-eight hours before the proposed time of surgery. The dosage depends on the age of the child. Children under three years of age receive 250 mg. every hour for four doses and then 250 mg. every four hours. Children between three and eight years of age receive 500 mg. every hour for four doses and then 500 mg. every four hours. Children over eight years of age receive 1 gm. every hour for four doses and then 1 gm. every four hours.

Following surgery the children are placed on a combination of intramuscular penicillin and streptomycin or a broad-spectrum antibiotic. We have given penicillin in the dosage of 300,000 units two times daily and streptomycin in two divided doses in the amount of 20 mg./kg. If a broad-spectrum antibiotic is used, the dosage schedule followed is 10 mg./kg. in three divided doses given parenterally. When oral intake is started again, the broad-spectrum antibiotic is given orally in three divided doses to the amount of 30 to 40 mg./kg. per day. Postoperatively the antibiotics are usually maintained for seven days and then discontinued. We have followed this regimen in a large number of cases and have had no complications that could be attributed to it. Careful bacteriological studies have been made in twenty-five of these cases and the following is a report of this study.

* Furnished by the Upjohn Company of Kalamazoo, Michigan.

BACTERIOLOGY

Stool cultures were obtained before starting the preparation of the bowel and again after completion. The bacteriological techniques for our stool cultures are as follows:

A swab or specimen of stool was obtained and plated on eosin–methylene blue agar, desoxycholate citrate agar, salmonella-shigella agar and azide agar. The specimen was also emulsified in 1 cc. saline solution, inoculated into tetrathionate and selenite broth for two hours and then plated on eosinmethylene blue, salmonella-shigella and desoxycholate citrate agar.

From that point, further identification of any given colony is carried out using Russell's double sugar slant, urea, fermentation and agglutination tests. Cultures are reported after forty-eight hours' growth.

Table 1 lists the cases studied. Fourteen patients were newborn to three years of age; eight patients were between three and eight

TABLE 1

Diagnosis	Treatment (Surgical)	No. of Cases
Imperforate anus with rectoperineal fistula	Anoplasty and closure of fistula	5
Congenital megacolon	Swenson's "pull-through" procedure	12
Lye stricture of esophagus	Colon esophagoplasty	2
Atresia of esophagus	Colon esophagoplasty	1
Extrophy of bladder	Ureterosigmoidal transplant	3
Intestinal polyposis	Excision of polyps, colectomy	2

years of age; and three patients were between eight and sixteen years of age. The pre-neomycin stool cultures that were obtained revealed the range of bacterial flora to be wide: Escherichia coli, alpha hemolytic streptococci, Proteus vulgaris, Pseudomonas aeruginosa, non-hemolytic Staphylococcus pyogenes (var. aureus), non-hemolytic streptococci.

The stool cultures following the course of neomycin revealed the following: no growth, twenty cases; few yeasts (not monilia), two cases; few non-hemolytic streptococci, one case; few non-hemolytic staphylococcus aureus, one case; Ps. aeruginosa, one case. In the latter case the patient was a five month old child operated upon for a rectovaginal fistula and imperforate anus. The patient had a benign postoperative course.

There were three postoperative complications in this series of operative procedures: In one patient a mechanical intestinal obstruction developed following a "pull-through" procedure. Stool cultures at surgery revealed "no growth." In one patient a leak developed at the anastomotic site following a "pull-through" procedure. Stool culture taken at surgery revealed "few non-hemolytic staphylococcus aureus." In the third patient there was partial breakdown of an anoplasty for imperforate anus. Stool culture taken at surgery revealed "no growth."

COMMENTS

The method of bowel preparation used in these patients consisting of bowel cleansing and administration of oral neomycin is effective and rapid. Mechanical cleansing is an extremely important part of this regimen. Neomycin cannot possibly eliminate bacteria from an intestinal tract filled with fecal impactions. The bacterial count is greatly diminished by a good cleansing enema, but remaining bacteria will rapidly repopulate the intestinal tract. A good bactericidal agent is necessary. We have found neomycin an excellent accessory to mechanical cleansing.

The rectal irrigations are done with as large a catheter as the rectum will admit. A six month old child will easily accept a No. 24 or No. 26 French catheter. Patience, persistence and saline solution are all needed in large quantities.

Two or our cultures were reported as containing yeast. It is fair to assume that these patients were adequately prepared for surgery. It is therefore proper to say that twenty-two of the twenty-five cultures taken in the operating room revealed those patients to be perfectly prepared, as regards the gastrointestinal tract, for surgery. The two patients whose cultures showed a few bacilli after careful culturing might be considered reasonably well prepared. In one case Ps. aeruginosa was cultured in large numbers and must be considered poorly prepared and a failure.

CONCLUSIONS

1. Systematic mechanical cleansing of the lower gastrointestinal tract is imperative for adequate preparation of a child for surgery involving the colon and rectum.

2. Neomycin is effective as the bactericidal agent in the preparation of children about to undergo surgery of the lower gastrointestinal tract.

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An Evaluation of the Indications for Exploration of the Common Duct

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HIGH epigastric or subxiphoid pain has long been recognized as a symptom of disease of the gallbladder. A series of patients with this type of pain prompted a review of 112 cases in order to evaluate this symptom in relation to others as an indication for exploration of the common duct. There are four findings which are generally accepted as indications for exploration of the common duct; we call them "absolute indications." There are four additional findings which call for exercise of judgment in each case; we call them "relative indications." (Table 1.)

ABSOLUTE INDICATIONS

Palpable Stones. This is the most accurate indication of a stone in the common duct. However, a lymph node or an indurated area in the pancreas can be mistaken for a stone. We have found it helpful to palpate the duct from the patient's left side and, following the procedure of Garlock [3], turn the duodenum to the left in order to palpate the duct more readily. More recently it has been our custom to pass a probe through the cystic duct, into the common duct and then into the duodenum, and to palpate the ducts over the probe. (Fig. 1.) In this way, we have found stones not only in the common duct but also in the cystic duct which had not been palpated previously.

TABLE 1
INDICATIONS FOR EXPLORATION OF THE COMMON DUCT

Absolute indications:
1. Palpable stone in the common duct
2. Jaundice at the time of operation or a reliable history of it
3. Pancreatitis (evidence at operation or history of previous attack)
4. X-ray evidence of stone in the common duct

Relative indications:
1. Dilated common duct
2. Stones in the gallbladder small enough to go through the cystic duct
3. High epigastric or subxiphoid pain
4. Aspiration of turbid bile from the common hepatic duct

Jaundice. Patients in this category had jaundice at the time of operation or just prior to operation, or associated with previous attacks of gallbladder disease.

Pancreatitis. Although the incidence of stones in the common duct is not great in patients with pancreatitis and cholelithiasis, it is generally agreed that the common duct should be explored in all of these patients. Even a negative exploration of patients in this group and in the group with jaundice affords an opportunity for dilating the ampulla which is sometimes stenosed.

X-ray Evidence of Stones in the Common Duct. One occasionally sees x-ray evidence of stones in the common duct on preoperative x-ray examination. Patients having stones diagnosed by a cholangiogram at operation also fall into this category.

RELATIVE INDICATIONS

A Dilated Common Duct. A dilated common duct is usually a relative indication for exploration. We consider the common duct dilated if the common hepatic duct is more than 1 cm in diameter just above the point of junction with the cystic duct. As the cystic duct is often intimately connected with or lies in the wall of the common duct for some distance distal to its junction, a measurement below its junction may give a false idea of the diameter of the common duct. In cases of acute cholecystitis,

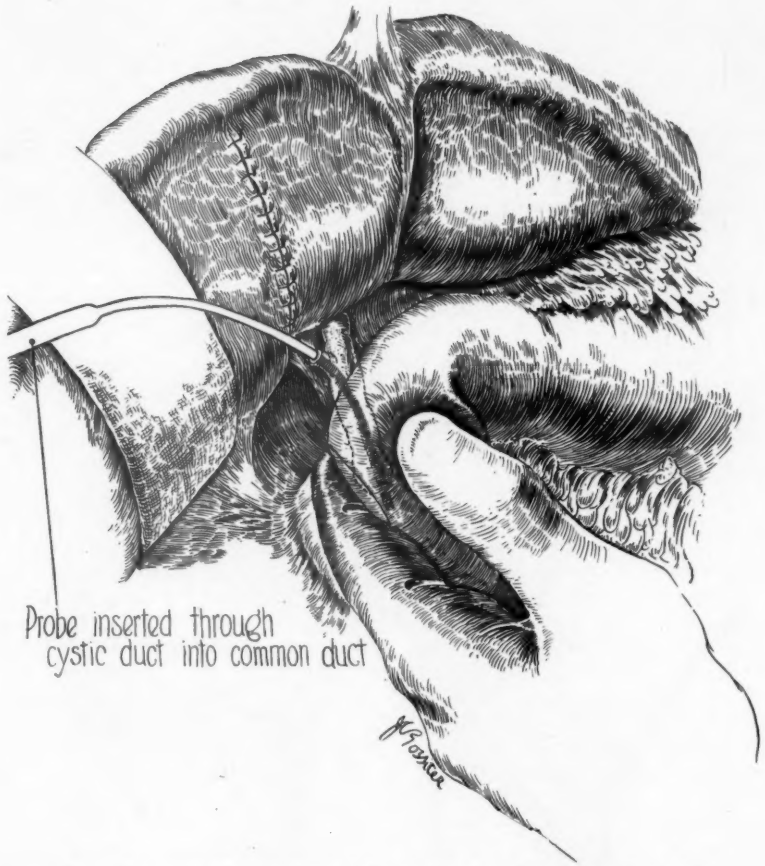

FIG. 1. Palpation of the common duct following reflection of the duodenum.

edema of the duct may give a false idea of its size. Certainly a duct greater than 1.2 cm. should be explored even though there are no other indications. Practically, however, there are nearly always other indications for exploration if the duct diameter is more than 1 cm.

We have measured the common hepatic duct in a number of cases. Dividers were used to make these measurements (Fig. 2) but the diameter of this duct can be accurately estimated by comparing it to a Bakes dilator of similar size, as has been suggested by Baker and Koutsky [1].

The Presence of Stones in the Gallbladder Small Enough to Pass through the Cystic Duct. After the gallbladder is removed, it is opened, and if any stones are found which are small enough to pass through the cystic duct, the question of exploration of the common duct arises. This is usually an indication for exploration although it is sometimes difficult to judge whether or not the stones are small enough to pass, and whether or not some have passed. A stone impacted in the cystic duct brings up this question. If the cystic duct distal to the impacted stone is small and there are no other indications, we do not always explore.

As stated previously, a probe may be passed through the cystic duct into the common duct with recovery of stones or gravel from the cystic duct which had not been known to be present. In these cases, exploration of the common duct should be carried out.

High Epigastric or Subxiphoid Pain. Zollinger [6,7] demonstrated that distention of the gallbladder caused deep epigastric pain, and

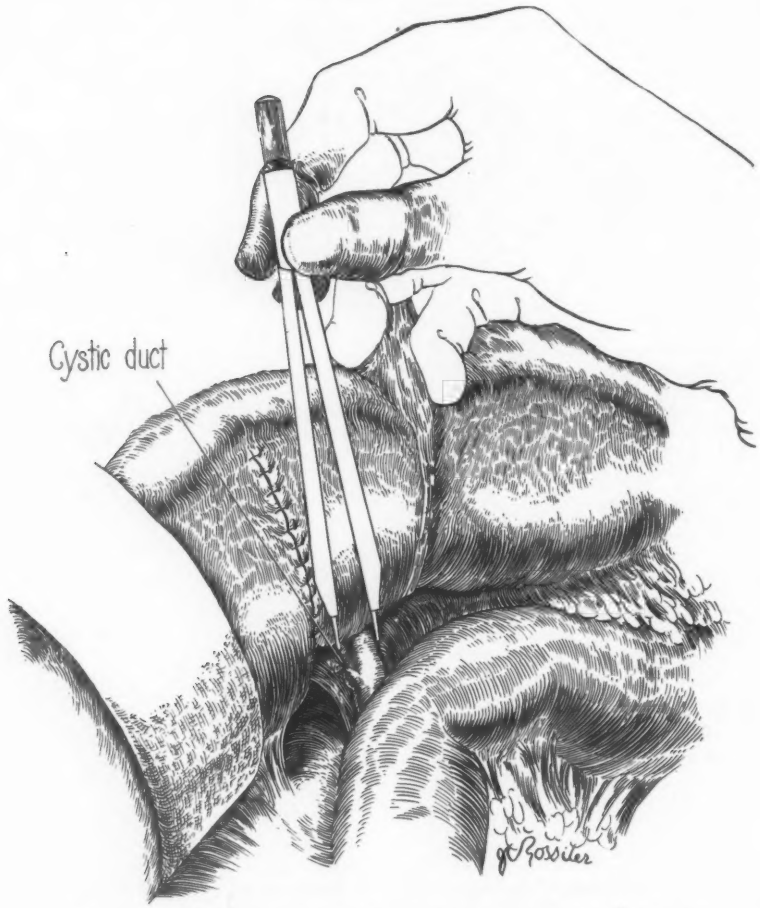

FIG. 2. Technic of measuring the diameter of the common hepatic duct.

that this pain was more severe and was accompanied by nausea and vomiting when the common duct was distended. Strohl et al. [5] found a high incidence of epigastric pain when stones in the common duct were present. The present study was prompted by our interest in evaluating this symptom as an indication of stones in the common duct.

Aspiration of Turbid Bile from the Common Duct. The presence of turbid bile or mucus in the bile is considered by some as a relative indication for exploration. Recently we have been aspirating the common hepatic duct just above its junction with the cystic duct. The cystic duct is ligated as soon as the cystic duct, common duct and cystic artery are well visualized. There is little probability that during this procedure turbid bile from the gallbladder will be expressed through the cystic duct into the common duct and become mixed with common duct bile at this level. After the gallbladder is removed, the common hepatic duct is measured and aspirated.

RESULTS

Table II shows the number of patients operated upon, the percentage of common ducts explored, the percentage of stones found in those explored and the percentage of common duct stones in the total series. The series is divided into two five-year periods. It was at the beginning of the second five-year period

TABLE II
SUMMARY OF EXPLORATIONS OF THE COMMON DUCT FOR THE TOTAL SERIES*

	No. of Patients	No. Explored	No. Positive for Stones	Total Patients with Common Duct Stones (%)
First 5 years...	120	30 (25%)	16 (53%)	13.3
Second 5 years.	194	82 (42%)	38 (46%)	19.6
Totals.....	314	112 (36%)	54 (48%)	17.0

* Mortality rate: four (1.2%).

TABLE III
SUMMARY OF CASES WITH "ABSOLUTE INDICATIONS" FOR EXPLORATION OF COMMON DUCT (NO. EXPLORED/NO. OF POSITIVE EXPLORATIONS FOR STONES)*

	Palpable Stones	Jaundice	Pancreatitis
Palpable stones...	8/8	9/9	0/0
Jaundice.....	9/9	27/16	5/2
Pancreatitis.....	0/0	5/2	9/1
All three.....	1/1	1/1	1/1
Totals.....	18/18	42/28	15/4
Per cent positive explorations....	100	66.7	27

* Sixty-eight per cent of the common duct stones were found in 53 per cent (fifty-nine cases) of the 112 common duct explorations performed. All had one or more of the "absolute indications" for exploration of the common duct.

that we became particularly interested in the symptom of high epigastric and subxiphoid pain as a sign of common duct stones and endeavored to gather sufficient information for evaluation. This interest in the indications for exploration of the common duct may explain the greater percentage of common ducts explored with the higher recovery rate of patient's with stones in the common duct in the second five-year period. It is estimated that stones in the common duct are present in about 20 per cent of patients with cholelithiasis. Our experiences seem to bear this out.

There were four deaths in the entire series, a mortality rate of 1.2 per cent. One death was from postoperative pneumonia in a patient seventy-nine years of age; two were from cerebrovascular accidents in patients sixty-eight and eighty-seven years of age; and one apparently was due to complications associated with narcotic addiction in a patient fifty-one years of age.

We have separated the 112 patients who had exploration of the common duct into two groups, i.e., those with "absolute indications" and those with only "relative indications." The patients in the first group present no problem as to whether or not the common duct should be explored. By separating these from the patients with only relative indications, it was thought that a better evaluation of the relative indications could be made.

Table III shows our findings in patients with "absolute indications" for exploration of the common duct. Many of these patients had more than one such indication as well as "relative indications." The presence of one of the absolute indications makes other factors unimportant in deciding on exploration of the common duct. There were no false positives in the group of eighteen patients with palpable stones. Forty-two of fifty-nine patients had jaundice with positive findings in two-thirds (twenty-eight patients). Fifteen had pancreatitis with positive findings in about one-fourth (four patients). Of the nine patients with pancreatitis as the only indication for exploration, a stone was found in only one (11 per cent).

There were no patients who demonstrated a stone in the common duct preoperatively, and we have not done enough cholangiograms at operation to evaluate this procedure.

It was observed that about half of our patients who had exploration of the common duct had one or more absolute indications, and over two-thirds of the explorations in this group gave positive results.

The patients with relative indications are listed in Table IV. About half the patients (47 per cent) undergoing exploration of the common duct had one or more of the relative indications but none of the absolute indications. The incidence of stones in the common duct in this group was 32 per cent compared to 68 per cent in patients with one or more of the absolute indications.

Contrary to our impression at the start of this study, epigastric pain was a blank failure and the least reliable indication.

A dilated duct plus one or more of the other relative indications seem to offer the best chance of finding a stone in the common duct; small stones with one or more of the relative

TABLE IV
SUMMARY OF CASES WITH "RELATIVE INDICATIONS" FOR EXPLORATION OF COMMON DUCT (NO. EXPLORED/NO. OF POSITIVE EXPLORATIONS FOR STONES)*

	Dilated Duct	Small Stones	Epigastric Pain
Dilated duct	1/0	5/4	3/2
Small stones	5/4	7/5	24/5
Epigastric pain	3/2	24/5	7/0
All three	6/1	6/1	6/1
Totals	15/7	42/15	40/8
Per cent positive explorations	46.6	35.7	20

* Thirty-two per cent of the common duct stones were found in 47 per cent (fifty-three cases) of the 112 common duct explorations performed. These had one or more of the "relative indications" for exploration of the common duct.

indications runs a close second, and epigastric pain a poor third.

We have only recently been aspirating the common duct to determine the presence of turbid bile. In thirty-one patients the common duct was aspirated; turbid bile was found in nine, six of whom were explored. Of these six, stones were found in the common duct in three (50 per cent). One patient had jaundice but no stones were found. The others undergoing exploration also had two other relative indications. Of the three patients not explored, one had small stones and two had small stones and epigastric pain. We now think they should have been explored. However, the number of cases is too small to warrant any conclusions. The patients who were explored have been included in the aforementioned groups under the appropriate indications. This finding deserves further study before its value as a diagnostic aid can be determined.

Glenn [4], Zollinger [8] and others have emphasized the higher incidence of stones in the common duct and other complications in the older age group. We have also found this to be true. (Table v.) There were 229 patients (73 per cent) under sixty-five years of age. Thirty-one per cent of these were explored. Stones in the common duct were found in thirty (42 per cent) of those explored, with an over-all incidence of 13 per cent in the patients under sixty-five years of age. There were eighty-five patients (27 per cent) sixty-five years of age or over. Forty-seven per cent of these were explored and stones in the common duct found in 60 per cent, giving an over-all incidence of 28 per cent in the patients sixty-five years of age or over.

TABLE V
EXPLORATION OF THE COMMON DUCT RELATED TO AGE

Age	No. of Cases	No. Explored	No. Positive for Stones	Total Patients with Common Duct Stones (%)
Under 65	229	72 (31 %)	30 (42 %)	13
65 and over	85	40 (47 %)	24 (60 %)	28

SUMMARY AND CONCLUSIONS

We have listed eight indications for exploration of the common duct. Four of these we consider "absolute indications" and the other four, "relative indications."

Stones in the common duct were found in 63 per cent of patients having an "absolute indication" and in 32 per cent of those explored having one or more "relative indications."

High epigastric or subxiphoid pain, contrary to our original impression, is the least reliable of the "relative indications." We do not think exploration of the common duct is indicated when this is the only relative indication.

Our experience does not warrant any conclusion as to the value of turbid bile in the common duct as an indication for exploration, but this merits further study and evaluation.

When two or more of the relative indications are present, the probability of finding stones in the common duct is much greater, and exploration is usually indicated.

Certainly one must explore some patients in whom only small stones or only a dilated common duct are present. These patients will continue to require the exercise of judgment based on history, and clinical, laboratory and operative findings.

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Gastric Atonia and Delayed Gastric Emptying after Vagotomy for Obstructing Ulcer

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From our experience we had the impression that prolonged postoperative gastric retention occurred in patients with obstructing duodenal ulcer more frequently following vagotomy and complementary drainage operations than after subtotal gastric resection. The frequency of this complication was observed in patients operated upon for pyloric obstruction to determine whether there was convincing evidence to support this apparent difference.

CASE MATERIAL

Seventy-two consecutive patients operated upon for obstructing duodenal ulcer were studied. Vagus resections were performed upon thirty-two patients, who averaged fifty-two years of age. The vagotomy was combined with gastroenterostomy in twenty patients, pyloroplasty in five patients, antrectomy and Billroth I anastomosis in six patients, and antrectomy and Billroth II anastomosis in one patient. The duration of complete pyloric obstruction in thirteen patients at the time of operation ranged from five to twenty-two days. In the remaining nineteen patients of the vagotomy group the obstruction had been partially or completely relieved for periods ranging from one to thirty-eight days prior to operation.

Subtotal gastric resection without vagotomy was performed upon forty-two patients whose average age was fifty-four years. A Billroth I operation was performed upon ten patients and a Billroth II operation was performed upon thirty-two patients. The duration of complete pyloric obstruction in nineteen patients at the time of operation ranged from two to twenty-six days. In the remaining twenty-three patients of the gastrectomy group the obstruction had been partially or completely relieved for periods ranging from two to forty-three days prior to operation.

Vagotomy and complementary drainage operations were performed upon forty-four consecutive patients with duodenal ulcer in whom the indications for operation did not include pyloric obstruction. The average age of these patients was forty-three years. They were operated upon concurrently with the patients with obstruction by the same group of resident surgeons. The vagotomy was combined with gastroenterostomy in twenty-five patients, pyloroplasty in sixteen patients and antrectomy in three patients.

RESULTS

A patient's postoperative course was considered complicated by delayed gastric emptying if he was unable to eat solid food by the tenth postoperative day and there was no evidence of mechanical or inflammatory obstruction to account for the difficulty.

Vagotomy and Ancillary Drainage Procedures for Obstructing Duodenal Ulcer. Postoperative delayed gastric emptying occurred in eight of thirty-two patients. Vagotomy and gastroenterostomy were performed in seven of the eight patients; vagotomy, antrectomy and Billroth II anastomosis were performed in one patient. Four of the eight patients in whom delayed gastric emptying developed had complete obstruction at the time of operation; one patient was given a liquid diet one day before operation and three patients were on soft diets for two, thirteen and twenty-six days prior to operation, respectively. The stomach of the last

patient was, nevertheless, markedly dilated and atonic. One patient not included in the group of eight cases of delayed gastric emptying was unable to eat for seventeen days after operation. Persistent gastric retention necessitated subtotal gastric resection three years later. In this patient delayed gastric emptying was the result of an inadequate gastroenterostomy stoma. Other complications encountered in this group were wound dehiscence, three cases; wound infections, three cases; and thrombophlebitis, one case.

The following case histories are those of the eight patients in whom delayed gastric emptying developed after operation.

CASE I. L. P., a sixty-two year old white man, complained of mid-epigastric pain of three months' duration which was accompanied by frequent vomiting. It was estimated that the patient had had partial pyloric obstruction for seventy-five days and complete pyloric obstruction for seven days prior to this admission to the hospital. Because of persistent complete obstruction after eight days of nasogastric suction, vagotomy and a retrocolic gastroenterostomy were performed. Although bowel sounds were audible and the patient passed flatus on the fourth postoperative day, there was persistent gastric retention. On the ninth postoperative day a wound dehiscence was repaired and a feeding jejunostomy performed. Subsequently gastric retention persisted for an additional seventeen days. During that period small bowel motility was sufficiently good to permit jejunal feeding and thereby the maintenance of a satisfactory nutritional state. The patient was afebrile throughout the entire postoperative period. Twenty-six months after operation he was asymptomatic and able to eat an unrestricted diet. He had regained his original weight and was in excellent health. Roentgenograms demonstrated a gastroenterostomy stoma that was satisfactory with respect to position and function.

CASE II. Q. W., a thirty-four year old Negro man, had had a duodenal ulcer for ten years that had precipitated two previous episodes of pyloric obstruction. For two years prior to his admission to the hospital he complained of increasing abdominal fullness, weight loss and frequent vomiting, which became progressively severe the last three weeks before admission even though his diet consisted entirely of liquids. After four days of gastric decompression by nasogastric suction the patient was able to tolerate an intragastric drip of protein hydrolysates. This was continued for four days and then vagotomy and gastroenterostomy were performed. At operation the pylorus was scarred and edematous; the stomach was dilated to twice the normal size. On the third postoperative day bowel sounds were audible and the patient passed flatus, but the stomach failed to empty and gastric retention persisted twenty-four days. Two years after operation the patient was in excellent health and roentgenograms demonstrated an excellent gastroenterostomy stoma with respect to position and function.

CASE III. J. C., a fifty-six year old white man, had had a duodenal ulcer for eleven years. He entered the hospital because of severe epigastric pain for three months and emesis of all ingested food for two days. The patient had complete pyloric obstruction which did not relent after six days of gastric decompression by means of nasogastric suction. Because the pancreas and common bile duct were incorporated in an extensive inflammatory reaction associated with the duodenal ulcer, vagotomy and an antecolic gastroenterostomy were performed. Bowel sounds were audible and the patient had a bowel movement on the fifth postoperative day although gastric retention persisted for thirteen days. On the thirty-third postoperative day, when the patient's stomach was emptying satisfactorily, abdominal perineal resection was performed. Gastric retention again developed, which did not subside until fourteen days after the second operation. The patient was afebrile after both operations. Roentgenograms two months later revealed a normal functioning gastroenterostomy stoma.

CASE IV. R. R., a forty-nine year old white man with a twenty-one-year history of peptic ulcer, had uncontrollable epigastric pain, vomiting and a 20 pound weight loss during the five weeks prior to entering the hospital. Roentgenograms demonstrated a dilated, secretion-filled stomach with hypoperistalsis and a large six-hour gastric residual. While the patient was in the hospital the pain subsided. He ate a bland diet and gained weight. After twenty-six days of conservative therapy the patient was operated upon. The stomach was dilated and its walls were thickened; the duodenum and pylorus were scarred, narrowed and acutely inflamed. Because of these findings vagotomy and posterior gastroenterostomy were performed. When bowel sounds were audible on the fifth postoperative day, the patient was given liquids and slowly graduated to a solid diet. Gastric retention subsequently developed and persisted from the tenth until the twenty-third postoperative day. The patient was afebrile during the entire postoperative period. One year after operation the patient was in excellent health with no gastrointestinal complaints. Roentgenograms revealed a satisfactory gastroenterostomy stoma.

CASE V. F. P., a sixty-eight year old white man who had had a duodenal ulcer for six years, entered the hospital because of recurrent pain for one week and frequent vomiting for two days. The patient had complete pyloric obstruction which persisted after five days of gastric decompression by means of continuous nasogastric suction. At the time of operation there was an obstructing anterior duodenal ulcer, which was treated by vagotomy, antrectomy and Billroth I anastomosis. Bowel sounds were audible on the fourth postoperative day, but a liquid diet was not attempted until the twenty-second day. This was not well tolerated and was discontinued after four days because of persistent gastric retention. The patient was afebrile following his operation. When the patient was reoperated upon on the thirty-seventh postoperative day, his stomach was dilated and the gastroduodenal stoma was widely patent. An antecolic gastrojejunostomy was performed. The patient was given liquids on the fifth day and appeared to tolerate them satisfactorily until the seventh day, at which time wound dehiscence and subsequent peritonitis occurred. Following repair of the wound dehiscence gastric retention persisted and the patient subsequently died after a fourth operation to relieve a small bowel obstruction. Postmortem examination revealed that both gastric stomas were patent.

CASE VI. H. A., a seventy-nine year old white man who had had a peptic ulcer for twenty years, entered the hospital with a perforated duodenal ulcer. Because of persistent pyloric obstruction for twenty days after closure of the perforation, vagotomy and gastroenterostomy were performed. Bowel sounds were audible on the fourth postoperative day, but the patient was unable to tolerate oral feeding until twenty-eight days after the second operation. Roentgenograms made during this period disclosed atony of the esophagus and stomach and a patent gastroenterostomy stoma located in the dependent portion of the stomach. The patient was afebrile during his hospital course. He failed to return for follow-up examination.

CASE VII. F. B., a sixty year old white man who had had symptoms of peptic ulcer for two years, entered the hospital because of intermittent vomiting for one month. Roentgenograms demonstrated 50 per cent gastric retention in six hours. Partial obstruction remained for thirteen days and at the time of operation the pyloric outlet was reduced by dense scarring to approximately 2 to 3 mm. in size. An antecolic gastroenterostomy and vagotomy were performed. Bowel sounds were audible five days after operation, but due to delayed gastric emptying the patient was unable to tolerate oral feeding until the thirteenth postoperative day. The patient did not return for a subsequent examination.

CASE VIII. W. B., a twenty-five year old Negro man who had had symptoms of peptic ulcer for six years, was observed to have partial pyloric obstruction for four months before he entered the hospital. The obstruction, while not complete, was of sufficient severity to require frequent self-aspirations of the stomach. Vagotomy and retrocolic gastroenterostomy were performed because of the chronic inflammatory constriction of the duodenum. Bowel sounds were audible on the third postoperative day and a bland diet was begun on the sixth day. On the fourteenth postoperative day, when it was recognized that the patient's stomach was not emptying properly, nasogastric suction was instituted and continued until the twenty-fourth postoperative day, when the patient was reoperated upon. The afferent limb of the gastroenterostomy was dilated and the efferent limb was collapsed. The gastroenterostomy stoma was inspected through a gastrotomy wound and was demonstrated to be widely patent. The obstruction remained for ten days, at which time subtotal gastrectomy and a Billroth II anastomosis were performed. The patient then made an uneventful recovery and was in excellent health when re-examined two years later.

Subtotal Gastric Resection for Obstructing Duodenal Ulcer. In none of the forty-two patients in this group did problems of prolonged gastric retention develop after operation. All patients were able to eat satisfactorily by the tenth postoperative day including the one patient who made an uneventful recovery following a wound dehiscence. Other complications which occurred in this group included wound infection one case, hemorrhage from the anastomotic suture line one case, pancreatic fistula one case, and thrombophlebitis one case. There was no mortality.

Vagotomy and Ancillary Drainage Procedures for Non-obstructing Duodenal Ulcer. None of the forty-four patients in this group fulfilled our criterion for delayed gastric emptying after vagotomy. In one patient small bowel obstruction developed which required re-exploration and lysis of adhesions. Wound dehiscence occurred on the seventh postoperative day in a second patient whose abdomen was not distended and who was satisfactorily tolerating a liquid diet. Ten days after repair of the wound dehiscence the patient was successfully started on a liquid diet. In our opinion this was not a case of delayed gastric emptying and the wound dehiscence was not related to the type of operation performed.

COMMENTS AND CONCLUSIONS

Gastric motility, diminished by vagotomy, is partially restored through a peripheral motor mechanism controlled by Auerbach's plexus [2]. It is recognized that return of gastric motility after vagus section is delayed if overdistention of the stomach is permitted. It was a reasonable hypothesis, therefore, that the decompensated musculature of a stomach, dilated as a result of pyloric obstruction, might be more susceptible to the atonic influence of vagotomy. Moore et al. [5] suggested that vagus resection performed in patients with pyloric obstruction might result in gastric dilatation extremely difficult to control despite gastroenterostomy. Weinberg et al. [6] stated that vagotomy and pyloroplasty are unsuited for patients with pyloric obstruction and for patients in whom the stomach is dilated and low hanging. He concluded that subtotal gastric resection or vagotomy and gastroenterostomy should be used under these conditions.

Although vagotomy and ancillary drainage procedures have been alluded to as unsatisfactory operations in cases of pyloric obstruction, we are unfamiliar with any report indicating the incidence of delayed gastric emptying in cases of obstructing duodenal ulcer treated by this method. Weinstein et al. [7] reported seventy-three cases of vagotomy and gastroenterostomy, of which thirty-three were for pyloric obstruction. In thirteen of the seventy-three patients moderate to severe postoperative gastric retention developed. The frequency with which this complication occurred among the patients with obstruction was not stated. Similarly, the report of the National Committee on Peptic Ulcer [4] analyzed 1,662 cases of vagotomy and drainage operations, of which 385 were performed in patients with gastric retention. Of the total number of cases, fifty-eight patients had persistent gastric retention and 252 had transient retention. No correlation was made between patients with preoperative retention and those with postoperative retention.

In the present study seventy-four patients with obstructing duodenal ulcer were treated either by vagotomy and a drainage procedure or by subtotal gastric resection without vagotomy. The patients in the two groups were comparable with respect to age, physical condition, length of history of ulcer, duration of obstruction and previous complications of duodenal ulcer. In spite of this similarity, all instances of delayed gastric emptying and the one death occurred in the vagotomy group. There were four instances of wound dehiscence; three occurred in the vagotomy group and two of these were among the eight cases of delayed gastric emptying. The occurrence of eight cases of prolonged gastric retention following vagotomy and drainage procedures in patients with pyloric obstruction suggested that this complication might be attributed to the unsatisfactory execution of the operation rather than to the type of operation. This possibility seems untenable since the same surgeons performed a larger number of vagus resections for conditions other than obstruction without the occurrence of prolonged gastric retention.

Dragstedt et al. [3] suggested that a gastroenterostomy stoma made in the dependent portion of a dilated stomach may be pulled up toward the spleen as the dilatation recedes and the stomach contracts. This mechanism will undoubtedly result in malfunction of a gastroenterostomy stoma; however, in seven of the eight cases of prolonged gastric retention reported in this paper the gastroenterostomy stoma was demonstrated by x-ray examination or at operation to be patent and in a satisfactory position. It appears unlikely, therefore, that delayed gastric emptying observed in our cases was the result of improper placement of the stoma. In our opinion the atonic effect of vagotomy superimposed upon an obstructed stomach already decompensated by dilatation provides a more acceptable explanation for the occurrence of a higher incidence of prolonged gastric retention after vagotomy and ancillary drainage operations than after subtotal gastric resection.

In this review it was of interest to note the occurrence of a dissociation between gastric and small bowel motility after vagotomy. This was exemplified by return of small intestinal motility prior to the readjustment of the peripheral motor activity of the stomach. The latter was not significantly influenced by the administration of Urecholine.® The dissociation of the gastrointestinal motility was best demonstrated by Case 1 in which the nutritional state of the patient was satisfactorily maintained by jejunal feedings for twenty-one days before gastric emptying was adequate.

The present study suggests to us that the

treatment of choice for patients with obstructing duodenal ulcer is subtotal gastric resection and Billroth II anastomosis. In our opinion the possibility of prolonged gastric retention after vagotomy is sufficiently great so that its selection is unjustified on the basis that a poor-risk patient can better withstand vagotomy than subtotal gastric resection. In our experience vagotomy was frequently selected because it was not considered technically safe to remove the ulcer. In this situation the stomach can be transected proximal to the ulcer, the antral mucosa excised to the pyloric ring and the stump closed according to the method advocated by Bancroft [1]. On the other hand, if vagotomy is to be employed in the treatment of patients with pyloric obstruction and large dilated stomachs, one must give meticulous attention to pre- and postoperative gastric decompression. More than the usual caution must be taken to insure that the gastroenterostomy stoma is of adequate size and located in the antral portion of the stomach. Finally, if one anticipates the possibility of prolonged gastric retention as a complication of vagotomy in patients with pyloric obstruction, the management of the nutritional problems that arise can be facilitated by the use of a jejunostomy feeding tube or a double lumen tube of the Puestow-Olander variety, which permits simultaneous gastric decompression and jejunal feeding.

SUMMARY

The problem of delayed gastric emptying in patients operated upon for obstructing duodenal ulcers has been studied. In eight of thirty-two patients with obstruction treated by vagotomy and complementary drainage procedures, gastric retention developed which persisted longer than ten days. One patient died as a result of this complication.

Delayed gastric emptying did not occur in any of the forty-two patients with pyloric obstruction treated by subtotal gastric resection. There were no deaths in this group.

In a series of forty-four patients treated by vagotomy and ancillary drainage procedures for reasons other than pyloric obstruction, there was no instance of delayed gastric emptying and there was no mortality.

In our opinion subtotal gastric resection is the treatment of choice for patients with obstructing duodenal ulcer. The results of this study suggest that vagotomy and a complementary drainage procedure is not a conservative operation in patients with pyloric obstruction.

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Experimental Replacement of Segments of the Upper Thoracic Aorta with the Aid of Vessel Couples

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THE earliest reports of the search for devices to simplify and speed the anastomosis of blood vessels appeared over sixty years ago [10,18]. A wide variety of materials has been used, but the basic methods have been limited in number. Vessels to be joined have either been intubated with foreign materials, onto which the vessel ends have been fastened or over which an anastomosis between the ends of the vessels has been made, or else vessel ends, one or both of which have been everted on a cuff of foreign material, have been brought into apposition and subsequently joined together by suturing, tying, clipping, wiring or stapling. These devices have ultimately been removed or left in place. Some have been of absorbable material (magnesium [16], bone [14], dextrose [21], fibrin [24], ice [26]), and some of non-absorbable material (ivory [15], glass [5,18], silver [27], vitallium [3], gold [22], brass [9], tantalum [30], polyethylene [6], methyl methacrylate [11] and nylon [7]). None has had wide clinical application thus far; yet the search continues with as much enthusiasm today [2,4, 12,19,28] as it did fifty years ago, when modifications of the Payr-like Crile cannula for direct blood transfusions proliferated [10,17,23]. Recent efforts range from the relatively simple bivalved cuffs of Fryfogle and his coworkers [8] to the quite complex and expensive Russian stapling machine described by Androsov [1]. The stimulus for this search is provided by the current interest in vascular surgery, in grafting of blood vessels, and in transplantation of organs.

A simple, removable, bivalved, stainless steel, cylindrical vascular clamp has been developed in this laboratory which can be applied to vessel ends with minimal interruption of blood flow [25]. (Fig. 1.) This device holds the edges of the joined vessels, or of the vessel and graft, in blood-tight atraumatic apposition, allowing a leisurely anastomosis with sutures to be made after blood flow has been re-established. It can also act as a holding device for the application of vessel clips.

The device has been tested in over fifty laboratory animals, using the carotid artery, the abdominal and thoracic aortas, and the aortic arch, and has had limited clinical use. This report recounts our experiences with the couple in the descending thoracic aorta of the dog.

METHOD

Adult mongrel dogs were anesthetized with intravenously administered pentobarbital sodium (Nembutal®) and, after endotracheal intubation, were given oxygen by an intermittent positive pressure apparatus. Through left thoracotomy, the upper descending thoracic aorta was isolated up to the level of the left subclavian artery, the first five or six intercostal arteries being divided between ligatures. After carefully measuring the diameter of the aorta at the first intercostal level with a small caliper, appropriate graft material was mounted on the two available vessel couples.* (Fig. 1.) The intact aorta was encircled with the extraluminal jaws of the couple, which were tied in place. Two braided wire loops were passed around the aorta and tied onto tonsil snares, for later use.

* Measurements of the two couples: (1) I.D. 8 mm., O.D. 9.5 mm.; and (2) I.D. 9.5 mm., O.D. 11 mm. Manufactured by Asheville Tool and Gauge Company, Asheville, North Carolina.

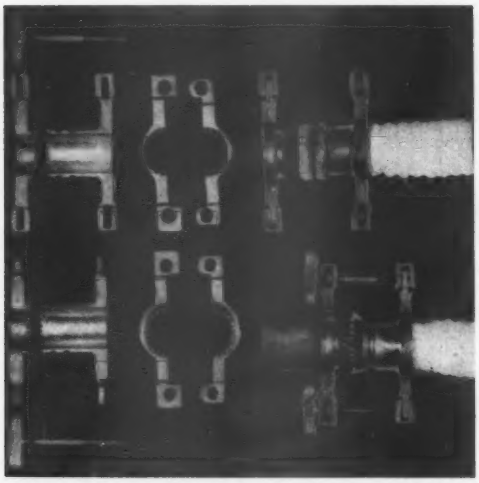

FIG. 1. *Left*, top and bottom, vessel couples disassembled, side and end-on views. Note jaws bearing fine teeth on one or two interdigitating ridges. Square cut grooves on shank of larger jaw are for temporary graft-everting ligature and for wire loop. *Right*, top, larger jaw upon which nylon tube has been everted and temporarily tied. *Right*, bottom, graft-bearing jaw has been slipped inside lumen of vessel and held in place by temporary wire loop (not shown). Bolts applied and tightened to grip vessel and graft edges. Tie on graft has been removed and suturing takes place while blood flows through vessel and graft. Upon completion of anastomosis, couples are disassembled and removed.

Holding sutures of fine silk were placed at suitable intervals in the wall of the isolated aortic segment to aid in controlling the proximal and distal vessel cuffs without damaging intima with instruments, and preparations were made to occlude this segment of the aorta and to intubate it with the graft-bearing vessel couples. When the graft had been preclotted with fresh blood (if necessary) and when all needed instruments were at hand, occlusive clamps were placed at the subclavian artery level and at the fifth or sixth intercostal level, and the intervening aorta partially incised (about half its circumference) proximally and distally, leaving sufficient aortic cuff on the bloodless side of each occlusive clamp to pull over the graft-bearing vessel couple. The two semicircular incisions were joined by a longitudinal incision, laying open the thoracic aorta. The proximal and distal aortic cuffs were now pulled over the graft-bearing vessel couples, and held in place by the wire loops attached to the tonsil snares. (A vessel couple holder, prepared by removing the transverse bars of a triangle-shaped lung clamp, proved useful in controlling the graft-bearing couples for this step.) The bolts for each couple were then applied and tightened sufficiently to prevent leakage of blood between vessel and graft but not tightly enough to damage the vessel walls. Blood flow was re-established by releasing the occlusive clamps above and below; wire snares were loosened, cut and removed, and the temporary tie holding the graft everted over the couple was similarly cut and removed by lifting up the overlying vessel cuff. The remaining portion of aorta lying behind the graft and between the two occlusive clamps was cut away. This left free the edges of vessel and graft for suturing in the usual manner with No. 5-0 silk, or for applying individual vascular clips prepared by modifying standard Cushing silver brain clips. On completion of both anastomoses, the couples were removed, the anastomoses being partially compressed by sponges until bleeding ceased. The grafted aorta was covered with pleura and the chest closed in layers. Antibiotics were used for one or two days after surgery.

A variety of materials was used for grafts, including homografts preserved in alcohol, unbleached teflon, crimped braided nylon (Edwards-Tapp tubes), nylon taffeta tubes with seams fused by heating, and lucite tubes patterned after Hufnagel valves, bearing short crimped nylon tubes wired on each end to provide a means of anastomosing the lucite tubes to the aorta. All were adaptable for use with these vessel couples.

RESULTS

In a series of twenty-five animals, twenty survived the operation, and fourteen lived for a period of weeks to months following surgery. In these the grafts functioned perfectly, with no evidence of paraplegia. The average period of aortic occlusion was six and a half minutes (range: three to sixteen minutes). The results are detailed in Table 1.

In the first seven animals, one Fryfogle and one Oteen couple on either end of the graft were used, as only a single model of the latter had been produced up to that time. The operation was in its developmental stage during this period and there were two operative deaths and two technical failures. Among the eighteen animals in which Oteen couples were available for both ends of the graft, there were three opera-

TABLE 1

Experiment Number	Weight of Animal (kg.)	Diameter of Aorta (cm.)	Time of Occlusion of Aorta (min.)	Graft Material Used	Result	Length of Survival	Remarks
1	15	1.3	16	Teflon	Good	4 mo.	Sacrificed; healed graft
2	17	1.3	12	Homograft	Poor	2 days	Thrombosis due to infolding of graft at operation
3	14	1.3	7	Homograft	Good	13 mo.	Sacrificed; healed graft
4	16	1.2	8	Teflon	Death	.....	Wire snare too large; slipped off couple
5	10	1.1	3	Teflon	Death	.....	Wire snare slipped off couple
6	18	1.4	4	Teflon	Good	9 mo.	Sacrificed; thrombus, non-occlusive, due to infolding at Fryfogle couple
7	13	1.1	5	Teflon	Poor	1 day	Thrombosis; graft too large
8	17	1.6	7	Crimped nylon	Good	5 mo.	Sacrificed; healed graft
9	20	1.5	3	Crimped nylon	Good	1 day	Died; overdose of Nembutal®
10	20	1.4	10	Crimped nylon	Good	11 mo.	Sacrificed; healed graft
11	20	1.5	3	Crimped nylon	Good	10 mo.	Sacrificed; healed graft
12	25	1.5	10	Crimped nylon	Good	8 mo.	Sacrificed; healed graft
13	28	1.6	6	Crimped nylon	Good	7 mo.	Sacrificed; intimal damage at distal anastomosis (possibly due to couple)
14	23	1.8	6	Crimped nylon	Poor	1 day	Cuff of vessel slipped partly off couple; oblique anastomosis with bulge on one side; turbulent flow; thrombosis
15	21	1.5	6	Lucite tube with nylon cuffs	Good	3 wks.	Died; thrombosis at lucite-nylon junction: healed graft
16	21	1.4	9	Lucite tube with nylon cuffs	Good	1 wk.	Died; thrombosis at lucite-nylon junction; healed graft
17	18	1.4	?	Nylon taffeta	Death	.....	Vessel half of couple pinched cuff and split aorta
18	21	1.4	4	Nylon taffeta	Good	1 day	Died; hemorrhage through taffeta
19	22	1.6	4	Nylon taffeta	Good	1 day	Died; hemorrhage through taffeta
20	18	1.4	3	Crimped nylon*	Good	4 mo.	Sacrificed; healed graft
21	14	1.1	..	Crimped nylon	Death	.....	Vessel too small; split in trying to pull over couple
22	22	...	4	Crimped nylon*	Good	4 mo.	Sacrificed; healed graft
23	19	1.2	6	Crimped nylon*	Death	.....	Vessel too small; wire cut through cuff
24	16	1.3	5	Crimped nylon	Good	1 mo.	Still alive
25	19	1.5	13	Crimped nylon	Good	1 mo.	Still alive

* One of the two anastomoses made with modified silver Cushing clips.

tive deaths and one technical failure with early mortality. Five of the eight failures of this technique occurred in animals with thoracic aortas the diameters of which were too small for the available vessel couples. There were three other early deaths and two later ones not related to the method. The remaining animals were sacrificed at intervals, and the graft and adjacent aorta examined, photographed and sectioned for histologic study. There was evidence of trauma from the vessel couples in only one animal. (Fig. 2.) The anastomoses were technically very satisfactory in every animal but one. (Fig. 3.) In one animal, in which the Fryfogle couple was used, a portion of infolded teflon not attached to the suture line became

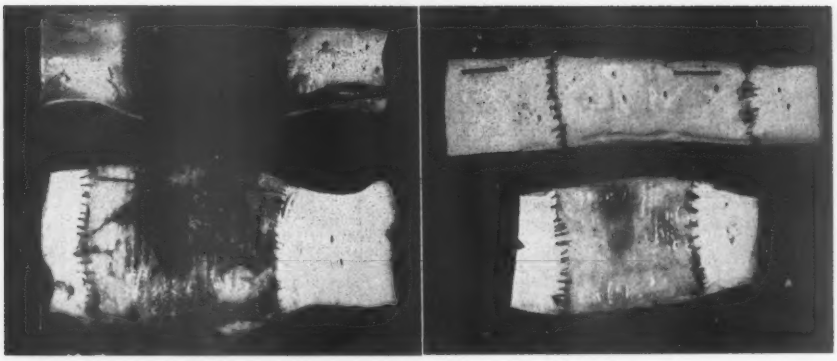

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FIG. 2. *Upper*, unbleached teflon graft, nine months after implantation into thoracic aorta, with the aid of one Fryfogle couple (anastomosis on left) and one Oteen couple (anastomosis on right). Using the blind suturing technique required by the Fryfogle couple, a portion of the teflon graft on the left was not picked up by the needle and lay in the blood stream. This served as a nidus for a thrombus which extended distally through the intact anastomosis on the right. *Lower*, Healed nylon graft seven months after implantation into thoracic aorta with the aid of two Oteen vessel couples. Intimal lining is incomplete. Heaped-up intima at anastomosis on the right appears to be the result of damage from teeth of vessel couple.

FIG. 3. *Upper*, healed alcohol-preserved homograft thirteen months after implantation, using Oteen vessel couples. *Lower*, healed nylon graft ten months after implantation, by the same method.

the nidus for a moderate-sized thrombus which did not occlude the vessel. (Fig. 2.) In two survivors it was possible to observe anastomoses made with the aid of metallic silver clips (Fig. 4), using the couples to make application of the clips possible.

COMMENTS

Some experience is necessary with this technique, as with any other. Provided that a small enough vessel couple is available to make possible the introduction of the graft-bearing portion into the vessel to be anastomosed, the technique is not difficult. Temporary partial constriction of the vessel by the extraluminal jaws of the couple is not of great moment, since it has been estimated that a 50 per cent reduction in the cross sectional area of the lumen of a vessel produces no reduction in flow [*13*]. It is more important to have a vessel couple smaller than the vessel to be cannulated, to make certain that the graft-bearing couple can be easily slipped into the vessel. From Table 1, however, it is obvious that the diameter of the dog's thoracic aorta is not readily predictable from its body weight; thus it is important to have a sufficient variety of couple sizes available to cover all the possibilities.

This couple possesses certain advantages over those which require eversion of both the host vessel and the graft. A thickened, diseased vessel is not readily everted, and may tear or break; however, it is usually possible to place something in its lumen safely, as in this technique in which eversion of the graft only is required. The Oteen couple seems to us to be safer than the Fryfogle couple which requires suturing of vessel and graft to take place blindly, by palpation in a groove. When there is a thickened diseased vessel, and moderately heavy graft material is used, it is difficult to palpate the groove and to place the sutures with certainty. One would prefer to have the edges of vessel and graft under direct vision.

Experience with the use of these couples in small vessels and in the ascending aorta and arch is still limited, but it is apparent from preliminary work that in these areas also it will prove to be useful. One envisions the use of devices of this type clinically to eliminate the need for shunts or hypothermia, or to shorten the time necessary on extracorporeal circulation, when necessary in the surgery of aneurysms, occlusive vascular disease, and transplantation of organs. They might also prove useful in suturing Hufnagel type valves into the thoracic aorta, thus eliminating the need for rigid multiple-point fixation rings.*

* This idea was suggested to us by Dr. John Rayl of Oteen, North Carolina.

FIG. 4. Aortogram of animal with nylon graft in thoracic aorta. Upper anastomosis made with Cushing silver brain clips, altered for this purpose; lower anastomosis in conventional manner using silk sutures. Inset shows this specimen four months after implantation.

A large-sized couple proved to be useful in resecting a thoracic aneurysm in a patient at a time when we were not yet equipped for extracorporeal circulation [*25*]. Although too short a cuff below the subclavian artery was available for use of a couple proximally, and a routine anastomosis had to be carried out at this point, distally use of the couple helped materially to shorten the time that it was necessary to occlude the thoracic aorta. Unfortunately this patient died nine days later of fulminating staphyloccal pneumonia, but at autopsy both anastomoses were found to be quite satisfactory, and the one performed over the couple was technically superior.

Further simplification of anastomosis of blood vessels in the direction of mechanically applied staples, clips or wires, in the manner suggested by the work of Samuels [*20*], Androsov [*1*], and Vogelfanger and Beattie [*29*], is in progress.

SUMMARY

Segments of the thoracic aorta of twenty-five animals were replaced by grafts of various kinds employing a bivalved, removable, circular vascular clamp (vessel couple) developed in our laboratory. The use of shunts or hypothermia was not necessary, since the clamps made possible introduction of the grafts into the aorta with interruption of blood flow for an average period of only six and a half minutes. The anastomoses were carried out after blood flow was re-established, and the couples were then removed. Twenty animals survived the operation and there were fourteen survivors for one week to one year. If a small enough couple was used, little technical difficulty was encountered. A

device of this type can be used on thickened diseased vessels, as well as normal ones, since eversion of the host vessel is not necessary.

Acknowledgment: I would like to acknowledge the help and encouragement of Dr. James D. Fryfogle in the early stages of this work.

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CASE REPORTS

Paget's Disease of the Male Breast

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ONLY seven documented cases of Paget's disease of the male breast have been reported in the English literature that is available to us for critical review. Four cases were reviewed by Sarason and Prior [1] with the addition of one of their own. Two additional cases were reported by Treves [2]. Because of the rarity and poor prognosis of this disease in the male, we are reporting a case of Paget's disease in a fifty-six year old Negro man, whose only symptom was bleeding from the nipple of six months' duration.

CASE REPORT

F. U., a fifty-six year old Negro man, was admitted to St. Mary's Infirmary on July 12, 1957, with a chief complaint of bleeding from the left nipple.

The patient stated that six months prior to hospitalization he first noticed blood on his undershirt where it came in contact with the left nipple.

FIG. 1. Numerous large neoplastic cells with clear cytoplasm, "Paget's cells," are present in the squamous epithelium over the nipple.

FIG. 2. The duct underlying the nipple is filled by the neoplastic cells.

The bleeding was intermittent during this period. There was no history of trauma or chronic irritation to the area. He had never experienced any pain or tenderness in the breast, nor had he noticed any ulceration or change in its size. The past history was essentially negative for abnormalities except for a duodenal ulcer, which was confirmed by x-ray examination and successfully treated medically. On examination, temperature, pulse, respiration and blood pressure were found to be within normal limits. He was well developed, well nourished, and the occasional bleeding his only complaint. The left breast appeared normal on inspection and was symmetrical with the right breast. On palpation, there was oozing of dark blood from the lower papilla of the nipple, which increased when pressure was applied. There was a thickening of the duct in this region, but no definite mass could be palpated. The right breast was normal. There were no palpable nodes in the axilla or supraclavicular regions.

The laboratory findings were essentially within normal limits, and the x-ray examination of the chest was negative for parenchymatous disease. The preoperative diagnosis was intraductal papilloma with no evidence of carcinoma. The patient was scheduled for surgery, and the breast was removed. A frozen section was not performed. The pathological diagnosis was that of Paget's disease associated with carcinoma of the duct. The patient was immediately prepared and reoperated upon. Radical mastectomy was performed. All the tissues were submitted for pathological studies.

On pathological examination, the first specimen (SMI-57-900) consisted of an ellipse of skin including the nipple, areola and underlying tissues. No lesion was noted, and the entire specimen was blocked for microscopic study. One of the original microscopic sections showed a typical area of Paget's disease of microscopic size (Fig. 1), and the underlying carcinoma of the duct (Fig. 2) was also evident. Numerous recuts of the block did not show additional involvement of the epidermis indicating the small size of the area.

The tissues from the radical resection (SMI-57-934) did not show residual tumor, nor were any of the axillary lymph nodes involved by neoplasm.

The patient's postoperative course was normal, and he was discharged on the eighth postoperative day. He has been re-examined on several occasions since discharge, and has not shown any evidence of recurrence or metastasis.

SUMMARY

A case of Paget's disease of the male breast is reported, the eighth case we could find recorded in the English literature. Bleeding from the nipple was the only symptom and significant physical finding. Although no palpable axillary nodes were found preoperatively, because of the reported poor prognosis of this disease radical mastectomy was performed.

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Abdominal Pregnancy at Term

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ABDOMINAL pregnancy is not diagnosed until operation in a high proportion of cases.

This case is presented primarily to show again how the condition may be positively diagnosed preoperatively by roentgenogram, particularly low voltage films. In 1942, Mattingly and Menville [*1*] emphasized the value of roentgenograms of the soft tissue. With the diagnosis established the surgeon can decide on the best technique for treatment before starting the operation. There is a difference of opinion concerning the proper treatment of the placenta. The course of this patient lends support to the position that the placenta should be left strictly unmolested at the time of operation.

CASE REPORT

The patient was thirty-five years old and had had three pregnancies with one set of twins. Her last menstrual period was on January 30, 1951. She was seen first on March 22, 1951 and her condition diagnosed as early pregnancy. On April 7, there was bleeding, enough to cause her to wear a pad. In May and June it was thought that the crampy pain and "gas" might indicate a threatened miscarriage. On August 1, 1951, examination showed what was thought to be a fibroid in the fundus of the uterus.

On October 24, the fetal head was noted to be low in the patient's pelvis. The patient complained of frequent urination and pelvic pain. She had lost 8 pounds during her pregnancy.

Labor did not occur as expected by November 6. On November 12, abdominal pregnancy was suspected because the rectal examination showed a thin covering for the head and a high anterior cervix.

Roentgenograms including low voltage films of soft tissue established the diagnosis by demonstrating the body of the uterus anterior to the fetus. (Fig. 1.)

The roentgenologist's* description of the films is as follows:

"Abdomen: (Antero-posterior and lateral roentgenograms using low and high kilovoltage techniques.)

"There is evidence of a single, well developed fetus, apparently approaching term, in the vertex presentation. The head is engaged and has descended to a "zero" station in the ROT position.

"The head is displaced posteriorly with approximately 3 cm. between the head and the symphysis pubis and approximately 1 cm. between the head and the sacrum.

"There is no evidence of a definite uterine shadow demonstrated over the upper portion of the fetus, although a faint outline consistent with the amniotic sac appears to surround the lower extremities of the fetus.

"There is a homogeneous shadow of soft tissue density extending upward from the symphysis pubis anterior to the fetus approximately 25 cm. This shadow is about 8 cm. wide. The upper pole of this shadow is rounded, consistent with the fundus of the uterus.

"Conclusion: Abdominal pregnancy with the hypertrophied uterus anterior to the fetus, displacing the head posteriorly."

The operation consisted in making a transverse incision in the right upper quadrant of the abdomen over the baby's breech. (Fig. 2.) The membranes were ruptured, liberating about an ounce of fluid. A large caliber rubber tube was inserted along the baby's back to the vicinity of the head to facilitate

FIG. 1. Lateral view of the abdomen preoperatively. A low voltage technique is used, demonstrating the hypertrophied uterus lying anterior to the fetus.

* Dr. M. M. Haskell.

FIG. 2. Photograph shortly after recovery showing transverse incision in the right upper quadrant, and lower abdominal swelling due to uterus on the right and placenta on the left.

FIG. 3. The newly born baby. No defects.

FIG. 4. After six years, the placenta was partially calcified, about 6 cm. in diameter and pushed the uterus to the right. Calcification was evident at four years.

FIG. 5. At about five months the areolas were still deeply pigmented.

the entry of air during the breech extraction of the baby. It was thought that there would be less disturbance of the placenta if this was carried out.

After extraction of the baby it was found that the cord pointed in the direction of the second lumbar vertebra, indicating a high attachment of the placenta and hence a probable attachment to the intestinal mesentery. Details of the attachment were not investigated. The cord was ligated with chromic catgut and severed. The abdomen was closed without disturbing the placenta. There were no drains. The baby was perfectly formed and weighed 7 pounds, 8 ounces. (Fig. 3.)

Postoperatively the patient had some distention and vomiting but recovered without much difficulty.

The child has developed normally and at the time of this writing is seven years old.

The placenta gradually shrank. At one month the top of the placenta was 19 cm. above the symphysis; at six months the measurement was 15 cm., at one year 11 cm. After two and a half years the placental mass was about 12 cm. in diameter. At four years the mass was about 6 cm. in diameter and calcification was demonstrated on the x-ray film. After six years the partially calcified mass still measured about 6 cm. (Fig. 4.)

At the time of this writing, the presence of the placenta has not seriously disturbed the patient. She complains of "gas and bloating" but never has been bothered enough to ask for its operative removal.

Endocrinologic observations were as follows: It was noted that the breasts remained flat, showing a small amount of milk secretion on the twenty-first day.

The areolas were deeply pigmented during pregnancy and were noted to be decreasing in color on February 6, 1952, although they were still very dark on April 11, 1952. (Fig. 5.)

The vaginal smears were reported as follows:* On November 20, 1951, eight days postoperatively, "Large numbers of navicular cells indicate gonadotropic effect." On November 26, "A few navicular cells remain. Red cells present."

* Smears made at Cedars of Lebanon Hospital, Los Angeles, California.

The results of endocrinologic tests* made on three days are shown in the following table:

	Normal	November 19, 1951	November 26, 1951	December 12, 1951
17-Ketosteroids	6–15 mg.	3.3 mg.	3.5 mg.	3.5 mg.
Estrogens	4–160 μg.	310 μg.	250 μg.	350 μg.
Pregnanediol	0–10 mg.	3.2 mg.	6.5 mg.	7.7 mg.
Chorionic gonadotropin	...	less than 300 mouse units/24 hr.	300 mouse units/24 hr.	less than 300 mouse units/24 hr.

Menstruation started about one and a half months after operation.

* Tests performed by the Bio-Science Laboratories of Los Angeles, California.

CONCLUSIONS

A case of abdominal pregnancy, delivery at term with survival of the mother and a normal baby is presented.

The x-ray report with illustrations demonstrates how the diagnosis can be proved, using the soft tissue technique.

Successful surgical treatment including avoiding disturbance of the placenta is described. The fate of the placenta is demonstrated by the partially calcified mass visible in the roentgenogram. Endocrinologic observations are presented.

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Hypoplasia of the Right Hepatic Lobe

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DEVELOPMENTAL variations in the anatomy of the biliary tract are not uncommon. These variations occur chiefly in the extra hepatic biliary tract and its vascular tree. Despite this variability in related structures, however, the liver itself is relatively free of major anomalous structural variation. It is for this reason that this rare anomaly of a hypoplastic right lobe is being reported. In this case the resulting position of the gallbladder created a most interesting situation at surgery.

CASE REPORT

A sixty-eight year old man presented with a four-year history of recurrent attacks of epigastric and upper abdominal pain. Although the attacks were suggestive of gallbladder colic, they were not quite typical, lacking right upper quadrant localization and radiation. Two studies failed to visualize the gallbladder. Preoperative liver function tests were within normal limits. There was no history of jaundice.

At laparotomy, through a right subcostal incision, exploration immediately disclosed the disconcerting fact that neither liver nor gallbladder were palpable in their usual positions in the right upper quadrant. Below the concavity of the diaphragm, in the place usually filled by the right lobe of the liver, the right colon and omentum were present. Further palpation then revealed what felt like a gallbladder containing stones high on the vault of the diaphragm. To the right of the falciform ligment only a small remnant of right lobe was present. The left lobe was normal in size, shape and appearance with no gross evidence of hepatitis or cirrhosis.

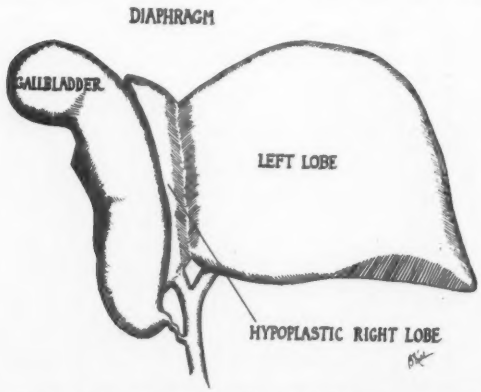

FIG. 1. Artist's representation of findings at surgery.

The incision was converted into a Kehr incision, confirming visually what was surmised by palpation. The right lobe was a flattened remnant to the right of the falciform ligament, comprising only about $\frac{1}{8}$ to $\frac{1}{10}$ of the normal right lobe volume. (Fig. 1.) One free edge bordered on the apex of the diaphragmatic vault. A rather elongated gallbladder, measuring 14 cm. in length, containing several stones, was present in the concavity of this hypoplastic remnant with the fundus extending beyond its edge and lying in juxtaposition to the right diaphragmatic apex.

Preliminary dissection of the structures in the triangle of Calot disclosed a normal common duct and cystic duct. The right hepatic artery seemed to be of normal caliber although this may have been the main hepatic artery. The portal vein divisions were not investigated. There was normal division of the common hepatic duct into right and left components. Two cystic arteries, one small and one large were present.

Because of the possibility of further developmental anomalies, the remainder of the dissection was performed in retrograde fashion. The inaccessibility of the gallbladder in its high subdiaphragmatic position rendered the procedure quite difficult but no further extension of the incision was necessary. Following retrograde dissection, the cystic arteries and duct were ligated, divided, and the gallbladder removed.

The postoperative course was uneventful save for the presence of a high fixed diaphragm on the right resulting in some discoid atelectasis. A postoperative abdominal film revealed the colon to be occupying the right upper quadrant, much as is seen in hepatocolic interposition. An earlier film of

the chest had also revealed a moderately high right diaphragm.

The chest findings gradually cleared and the patient left the hospital on the ninth postoperative day.

The pathologic report indicated chronic cholecystitis and cholelithiasis.

EMBRYOLOGY AND NORMAL ANATOMY

The liver is a ventral outgrowth of the foregut entoderm. At the 4 mm. stage of the embryo it exists as a single lobule. At 7.5 mm. it has become bilobed and growth thereafter by lobular multiplication is rapid. Originally, with its attachment to the septum transversum, it lies high in the embryo, opposite the occipital and cervical myotomes. It then descends as the septum moves caudally and at four weeks it bulges into the abdominal cavity Originally the lobes are of equal size but after the third month the right becomes larger. This growth differential has been credited to differential portal blood flow, preferential flow from one umbilical vein, availability of space and pressure atrophy from adjacent organs (e.g., stomach on left). Whatever the reason, at birth the disparity in size between the right and left lobes is quite evident. This asymmetry increases until the definitive lobar relationships are attained in early childhood.

In the adult, recent studies have indicated a segmental pattern of division into lobes. For the purposes of this discussion however, we will adhere to the old concept that the division into right and left lobes is at the line of the falciform ligament and ligamentum venosum. Considered thus, the right lobe in the adult comprises approximately $\frac{4}{5}$ to $\frac{5}{6}$ of the liver volume by weight.

ANOMALIES OF THE HEPATIC LOBES

Perhaps the best known of the hepatic anomalies is Riedel's lobe which consists of lateral elongation of the right lobe towards the right lower quadrant. Its chief importance is the possibility of its being mistaken for a pathologic intra-abdominal mass.

Other anomalies that have been described include accessory lobes, abnormal fissures and lobulations, abnormal smallness of the entire liver and hypoplasia of the right or left lobe. It is with the latter group (hypoplasia) that we are primarily concerned herein.

The finding of an abnormally small or completely atrophic left lobe in the non-cirrhotic liver has been described with relative frequency. In a thirty-year period, thirty-two such cases were observed at the Mayo Clinic [3]. The lobes varied in appearance "from a shrunken or normal configuration to flattened, spatulous remnants. Often capsules were grossly wrinkled." Among the causes of such left unilobar atrophy are selective portal vein obstruction, biliary duct obstruction, and long standing severe malnutrition. In the latter group the "streamlining" or laminar flow of the portal blood, in which the left lobe receives relatively little of the small intestinal portal return, may be responsible for the atrophy. In some cases there is no discernible cause and a congenital variation is quite likely.

The right lobe, in contrast to the left, is rarely the site of unilateral atrophy or hypoplasia. One must resort to the older European anatomical or pathologic literature for examples of such anomalies. In 1896 Jacquemet [5] described it once in 200 instances of hepatic lobar anomalies. Quoted in Hanser's section on the liver [4], in a famed German text on pathology, are two cases similar to the one described herein. One was a patient of Kaufman, in whom the right lobe was absent and the gallbladder was at the right border of the liver. Heller in Virchow's Archives also reported a case of defective development of the right lobe in a man forty-five years of age. In place of the normal right lobe there was only a heart-shaped rudiment extending toward the hypochondrium. The gallbladder lay between the right upper border of the liver and the diaphragm.

In the case presented herein the lack of compensatory hypertrophy of the left lobe favors a congenital origin of the lobar hypoplasia. From recent studies on patients who have had total right lobectomies [9] it is evident that the liver can perform with little or no dysfunction when only $\frac{1}{5}$ or $\frac{1}{6}$ of its substance remains. However, in the patient who has undergone hepatectomy a true regenerative hyperplasia occurs following surgery. The exact stimulus for this remarkable regeneration is not clear. That it is dependent in some measure on venous flow has been clearly shown experimentally. In the congenitally hypoplastic lobe there is apparently no stimulus for hyperplasia of the remaining lobe.

SUMMARY

Unilobar atrophy or hypoplasia involving the hepatic lobes is not uncommon on the left side. It is distinctly uncommon on the right, where it probably represents a developmental anomaly if no other etiological factor is demonstrable. In the case reported a small right hypoplastic lobe was encountered at surgery for calculous cholecystitis.

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Ruptured Anterior Nucleus Pulposus between T1 and T2 Causing a Discrete Esophageal Defect and Minimal Dysphagia

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A REVIEW of the literature fails to reveal a case similar to the one we are reporting. It is unusual in that the nucleus pulposus between the first and second thoracic vertebrae ruptured anteriorly causing a discrete extrinsic defect on the esophagus at that point.

CASE REPORT

Mrs. A. M., a forty-two year old white woman, entered Our Lady of Lourdes Hospital in Binghamton, New York, on March 17, 1958, for a diagnostic esophagoscopy. She had seen her internist (N. B.) at his office several weeks previously complaining of a vague sensation of pressure in her neck and slight difficulty in swallowing her saliva of about six months' duration. Solid foods were swallowed without difficulty and there was no history of regurgitation or vomiting. There was no weight loss. An esophagram taken on an outpatient basis revealed a discrete filling defect in the upper dorsal esophagus at about the level of T2. (Fig. 1.) Lateral esophagrams showed no abnormality. On physical examination, the vital signs were normal and no masses were palpable in the neck. The thyroid gland showed no abnormalities. Esophagoscopy was performed with the patient under local anesthesia on March 18 and was essentially unremarkable. The mucosal pattern was redundant, smooth and pale pink but there was no evidence of intrinsic or extrinsic pathology.

The patient was discharged home and readmitted to Charles S. Wilson Memorial Hospital in Johnson City, New York, on April 7, 1958, for esophageal exploration. Prior to surgery repeat esophagrams had showed the same defect. On April 10 the patient was taken to surgery and her neck explored through the usual collar incision. The thyroid gland was minimally diffusely enlarged but contained no nodules. The parathyroid glands showed no abnormalities. In order to obtain exposure to the esophagus, the middle thyroid veins and the inferior thyroid veins and arteries were divided between ligatures. The right recurrent nerve was identified and isolated. The trachea was normal. The esophagus, which lay almost completely to the left of the trachea, was freed of its prevertebral fascial attachments and cleared superiorly and inferiorly. It was free of pathology. Palpation of the vertebral column revealed sharp osteophytic spurring of T1 and T2. As one inspected this area visually, fragments of fibrocartilage were seen lying free. These had extruded through a small transverse tear measuring 1.5 cm. in the anterior longitudinal ligament. Forceps were used to pluck out several more fragments of fibrocartilage. A small silver clip was attached in the anterior longitudinal ligament at the point of rupture for postoperative identification. (Figs. 2 and 3.) Closure was done in the routine fashion with drainage.

Postoperatively the patient did well. However, her voice was somewhat husky, and laryngoscopy revealed some weakness of the left vocal cord. This condition cleared completely in three months. The patient no longer has difficulty swallowing her saliva and is not cognizant of a pressure sensation in her neck.

The pathological report stated that the specimen consisted of four irregularly shaped segments of firm pinkish white tissue. The microscopic appearance was that of fibrocartilage consistent with nucleus pulposus.

COMMENTS

The literature not uncommonly mentions hypertrophic arthritis of the cervical spine as a cause of dysphagia and difficulty with esophagoscopy [1,3–5]. Suggestions for treatment range from resection of the bony exostoses to gastrostomy in the more debilitated patients. A recent report by Patterson and Byerly [7] gives credence to the success of resection of cervical exostoses.

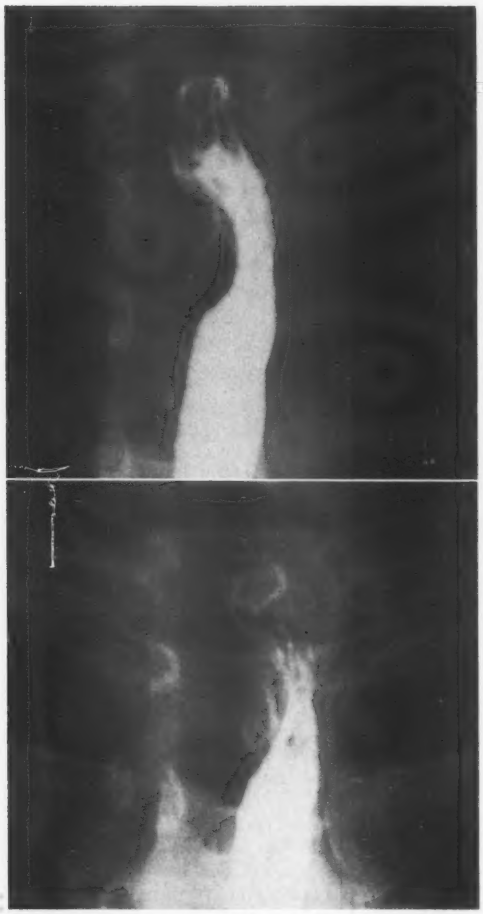

FIG. 1. Posteroanterior barium swallow showing the discrete extrinsic defect on the esophagus at the level of T2. Lateral esophagrams failed to show any abnormality.

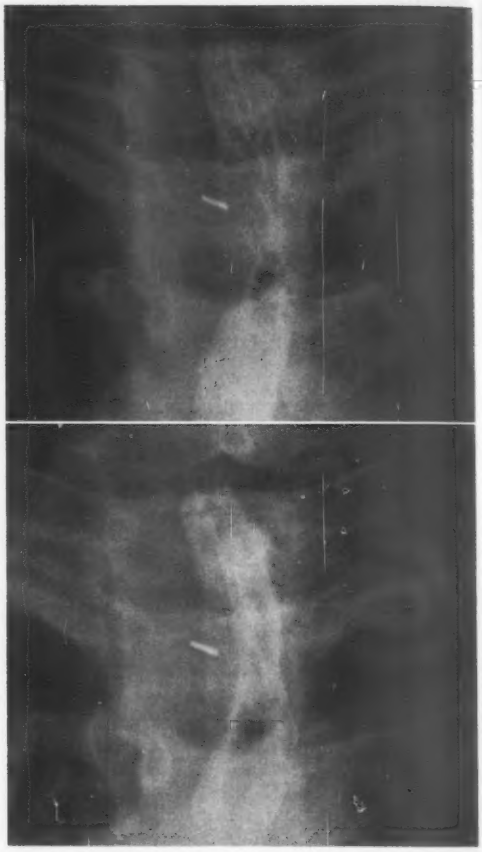

FIG. 2. Posteroanterior esophagrams taken five days postoperatively showing a silver clip in the interspace between T1 and T2 and diminution in the size of the defect.

Batts [2], in his excellent anatomical study of fifty spines, showed that the anterior protrusion of the nucleus pulposus was extremely rare; it occurred in only 6 per cent of his cases studied and these were in the lumbar area. He claims that the osteophytic proliferation that does occur is secondary to the disc protrusion.

Jacobson and Wicht [5] support the aforementioned theory that hypertrophic spurs are a constant development in the degeneration of an intervertebral disc. They believe that disc degeneration occurs most commonly in those sites which are subject to the greatest extent of movement, namely, the lowest four cervical vertebrae, the lowest three lumbar vertebrae and the lumbosacral interspace.

Lyall [6] performed exploration on a patient with a mass in the right lower area of the neck. This structure was cystic and its neck originated between C5 and C6. He postulated that this originally represented a ruptured anterior disc.

In some patients the bony excrescences can be palpated by careful examination of the neck. Kertzner and Madden [4] were able to feel the deformity in one of their patients. They were of the opinion that the greater fixation and the lack of mobility of the esophagus in the lower cervical area accounted for the difficulty more so than the deformity.

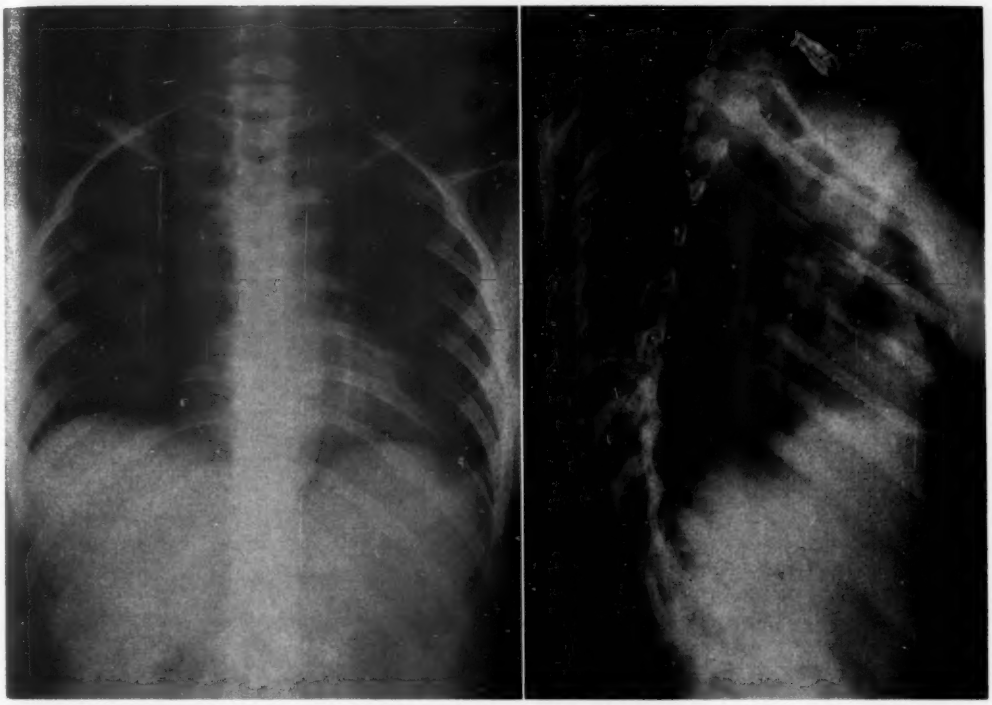

FIG. 3. Posteroanterior and oblique views of the cervicodorsal spine showing the silver clip at the interspace between T1 and T2. Osteophytic lipping is noted at the lower cervical and lower dorsal vertebrae.

The findings in our patient came as a surprise. In the differential diagnosis abnormal growths of the thyroid or parathyroid glands were considered, as were benign extramucosal tumors of the esophagus. Certainly in this area, according to Terracol and Sweet [8], unilateral enlargements of the thyroid gland, bronchogenic cysts or neoplastic involvement of the lymph nodes must be considered.

It was believed that freeing up the esophagus from its cervical prevertebral fascia would give it enough mobility to nullify the effects of the protruding osteophytic spurs. Osteotomy did not seem to be necessary.

Thoracic surgeons should be more aware of the possibility of cervicothoracic vertebral pathology in compressing or altering the contour of the esophagus. This type of lesion admittedly is rare but it should be considered in the differential diagnosis of extrinsic defects of the esophagus especially when osteophytic bony pathology is evident.

SUMMARY

1. An unusual case of esophageal defect is reported due to rupture of the nucleus pulposus between T1 and T2. The only symptoms were a vague pressure sensation in the neck and slight difficulty in swallowing saliva.

2. Review of the literature fails to reveal a similar case.

3. This type of esophageal defect must be rare but should be listed in the differential diagnosis of extrinsic defects of the esophagus.

Acknowledgment: Reproductions of the x-ray films were made through the courtesy of Ansco, Binghamton, New York.

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Surgery Court Cases

HOWARD NEWCOMB MORSE,* *Chicago, Illinois*

FITZGERALD VS. LEACH

Supreme Judicial Court of Massachusetts

150 N. E. 2d 12

This was an action for malpractice in the Superior Court of Suffolk County, Massachusetts, wherein the jury returned a verdict for the plaintiff-patient and the defendant-surgeon appealed.

The patient, who was fifteen years of age, sought to recover damages for personal injury sustained by her as the result of negligence on the part of the surgeon in the performance of an operation on her left wrist. She had pushed her left hand through two panes of glass and suffered a laceration of her left wrist and flexor tendons.

The operative report showed that all the superficial tendons, except the flexor tendon to the little finger, had been severed. The deep tendons were intact. The "upper band of the tendon was isolated and brought down and sutured to the wound." The skin was then closed. The patient remained in the hospital for four days. Her hand was in a plaster splint and bandages for several weeks.

Following the removal of the cast the patient went to a highly reputable hospital for physiotherapy where the physiotherapist discovered loss of median nerve function. She was referred to the Neurosurgical Clinic of the second hospital where confirmation of palsy of the median nerve was made. She was then admitted as a house patient for exploration of the median nerve.

Exploratory operation by a second surgeon disclosed that the proximal segment of the median nerve was sutured to the distal portion of the sublimis tendon going to the middle finger. The distal end of the median nerve was found lying free. The nerve ends were trimmed and anastomosed with No. .003 tantalum wire. The tendon was sutured with No. 4-0 silk. The diagnosis was: median nerve palsy, left proximal median nerve sutured to distal flexor sublimis tendon.

The patient made some degree of recovery, but she had a sensory loss at the base of her palm which affected her ability as a typist. There was a lump in her left wrist which is called a neuroma (a group of nerve fibers which grow into a ball when after suturing they do not grow back into the nerve sheath). The median nerve is approximately the same size as the sublimis tendon but its color is slightly different. The texture of the sublimis tendon is more firm than that of the median nerve, which may be compressed with one's fingers. Anatomically, the median nerve is not at any time connected with the sublimis tendon. The records of the second hospital showed that one end of the median nerve was lying free in the wound. The operation performed there was necessary to suture the median nerve properly.

So far as the median nerve was concerned, the result unfortunately was not good. If the median nerve had been completely sutured instead of leaving one end lying loose in the wound, and if one end of the median nerve had not been sutured to the sublimis tendon, the probabilities are that the patient would have obtained a better result from the operation performed by the first surgeon. If the median

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nerve had been properly sutured by the first surgeon, the patient probably would not have suffered a neuroma, which produced the sensory loss.

The Supreme Judicial Court of Massachusetts affirmed the decision of the court below. The Supreme Judicial Court declared: "We are of opinion that the jury could warrantably find that the defendant (the first surgeon) was negligent in not distinguishing the sublimis tendon from the median nerve . . . the operation was not done with the care and skill generally used and possessed in this community (Boston) . . . the defendant was negligent in his treatment of the plaintiff."

RURAL EDUCATIONAL ASSOCIATION VS. BUSH

Court of Appeals of Tennessee

298 S. W. 2d 761

This was an action against a private hospital for injuries received when the surgeon, who was on the resident staff, left a sponge in the patient's intestine after an operation due to the nurse's miscount of sponges. A jury in the Circuit Court of Davidson County, Tennessee, returned a verdict for the patient and the court entered judgment accordingly. The hospital appealed.

In connection with the abdominal operation on the patient, the nurse placed in the surgery room certain sponges which were necessary for use during the operation. The approved and commonly used type of sponge for such operations has a long tape fastened to the sponge at one end of the tape, with a safety ring at the other end. This tape and ring hang outside the incision as a safety measure or precaution against the possibility of leaving the sponge in the abdomen. When this type of tape is used it is impossible to close the incision and leave the sponge in the body, for the tape and ring would be hanging on the outside of the incision. The nurse who prepared for the operation did not provide this type of sponge. She merely provided and used sponges without safety tapes and rings attached.

The surgeon inquired as to the sponges and was informed by the scrub nurse that the sponges were all accounted for, whereupon the surgeon closed the incision. No circulating nurse had been provided for the operation, although one was required and commonly used. The sponges had not been correctly counted. One large, long sponge was left in the abdomen of the patient and lodged in one of his intestines.

The Court of Appeals of Tennessee sustained the decision of the lower court. The Court of Appeals stated: "When a nurse acts under the orders of a private physician in matters involving professional skill and decision, she is absolved from liability for her acts. Many acts of a nurse, however, do not result from orders of the physician. Furnishing proper personnel and equipment for an operation are duties of a hospital. The selection of proper sponges was the duty of the hospital. Counting the sponges so as to see that no sponge was left in the body of the patient required no special professional skill or decision of the surgeon. Indeed . . . (the surgeon) relied upon the sponge count of the nurse. In these matters we hold the jury were justified in reaching a factual conclusion that the nurse was the agent of the defendant (the hospital)."

Case Analysis Clinic

The step-by-step management of an acute abdominal problem in an elderly male patient.

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PATIENT S. S., a seventy-one year old man, was admitted with a two-month history of increasing constipation, decreasing stool caliber, anorexia and vague bilateral lower abdominal discomfort associated with crampy pain in the left lower quadrant. The pain was of rapid onset, lasted several minutes and was relieved by defecation. Laxatives and enemas were found increasingly necessary. There was a 20 pound weight loss during this two-month period. Three weeks before admission the abdomen was said to be enlarged and an oral temperature of 103°F. was noted. Three days prior to admission nausea, vomiting and increasing abdominal distention without hematemesis or melena developed. Since 1953 repeated episodes of mild mid- and lower abdominal crampy pain had been noted.

Past history was non-contributory except for suprapubic prostatectomy for benign hypertrophy of the prostate and cystotomy with fulguration of a transitional cell carcinoma of the urinary bladder two years previously. Six months prior to admission recurrent hematuria developed and two months before hospital entry a recurrence of carcinoma of the bladder was fulgurated. Barium enema examination at that time disclosed numerous diverticuli from the ascending colon to the rectosigmoid. An area of irregularity in the upper sigmoid colon was interpreted as diverticulitis.

PHYSICAL EXAMINATION

Examination showed a moderately obese, elderly male with generalized abdominal discomfort but no severe distress. Temperature was 98.6°F. orally; pulse, 88; respiration, 22; and blood pressure, 140/90 mm. Hg. Slightly decreased turgor of the skin was noted. The heart and lungs presented no significant abnormality. No lymphadenopathy was found. The abdomen appeared moderately distended but soft. Mild tenderness of the left lower quadrant with voluntary muscle guarding was present, but no rebound tenderness was noted. High-pitched tinkling peristalsis with rushes was heard. No abdominal mass was palpable and the liver, spleen and kidneys were not felt. On rectal examination, the ampulla was void of feces and no masses were palpated in the cul-de-sac.

LABORATORY DATA

The red blood count was 4.25 million per cu. mm.; hemoglobin, 11.5 gm. per cent; white blood count, 12,700 per cu. mm. with 5 nonsegmented and 66 segmented neutrophils and 29 lymphocytes. Urinalysis showed a specific gravity of 1.025; pH, 5.0; 10 mg. per cent of protein and five white blood cells per high-power field. The blood urea nitrogen was 10 mg. per cent; carbon dioxide combining power, 45 volumes per cent; serum sodium, 146 mEq./L.; serum potassium, 3.8 mEq./L.; serum chloride, 109 mEq./L.; total protein, 7.1 gm. per cent with 3.9 gm. per cent albumin and 3.2 gm. per cent globulin.

Flat and upright films of the abdomen demonstrated a 6 cm. diameter distention of the transverse and descending colon with air and fluid levels, and a tapering total obstruction to the air column in the hollow of the left ileum. Two small areas of gas were noted in the rectosigmoid. No dilated loops of small intestine or free air were present beneath the diaphragm. The chest film was normal. Barium enema examination shortly after admission showed that barium passed readily through the

rectum and partially into the sigmoid. In that area a complete obstruction was seen. Sigmoidoscopic examination to 22 cm. was negative for polyps, carcinoma or diverticuli. No feces, blood or mucus were seen.

DIAGNOSTIC PROBLEMS

Several points had to be evaluated to provide a rational basis for management. Was this a mechanical obstruction? If so, was it large or small bowel, partial or complete? What was the etiology of the obstruction? Was the obstruction complete enough to require immediate surgical intervention? What were the necessary preoperative preparations?

Was This a Mechanical Obstruction; Large or Small Bowel, Partial or Complete?

Both the history and physical findings presented a fairly typical picture of a mechanical obstruction. There was intermittent crampy abdominal pain associated with decreasing stool caliber, abdominal distention, nausea, vomiting and increasing constipation. This, coupled with the physical findings of high-pitched tinkling peristaltic rushes, presented a characteristic picture of mechanical bowel obstruction.

Flat and upright films of the abdomen demonstrated distention of the large intestine with air and fluid. No air-filled small intestinal loops were seen. The barium enema clarified at once the presence of an obstruction in the sigmoid region. In addition, it pointed out the completeness of the obstruction since barium, even under pressure, was not seen to pass through. The absence of air in the rectum also pointed to a very high grade of obstruction.

What Was the Etiology of the Obstruction?

Carcinoma, volvulus and diverticulitis (in this order) are the most frequent causes of obstruction of the left colon in the older age group. Fecal impaction occasionally leads to obstruction of the lower left colon in elderly sedentary persons. External hernias and intra-abdominal adhesions on occasion are also responsible for sigmoid obstruction.

The history of increasing constipation, decreasing stool caliber with progressive increase in use of laxatives and enemas over the previous two months all spoke for a progressive occlusion of the lower colon, as is seen with carcinoma. The absence of melena is not usual with carcinoma, although in many instances it does not occur, or at least the patient does not notice it. Repeated episodes of lower abdominal pain over the previous two years are inconsistent with carcinoma if related to the obstructive lesion. Repeated episodes of lower abdominal pain are common with recurrent exacerbations of diverticulitis. Barium enema examination two and a half months prior to admission demonstrated widespread diverticulosis with an area of irregularity in the sigmoid colon. This was diagnosed as diverticulitis. The oral temperature of 103°F. three weeks prior to admission may well have represented a systemic response to inflammation about a localized abscess from diverticulitis.

The tapering air column above the site of obstruction in the lower left colon suggested diverticulitis, since obstruction from diverticulitis is due to edema both of the bowel wall and adjacent mesentery. This is accompanied by localized muscle spasm which sometimes results in a funnel-like decrease in the caliber of the lumen. Obstruction from carcinoma in this location is usually due to an annular constriction with a sharper cut-off of the lumen.

Since the huge loop of colon shaped like a coffee bean, which is seen with volvulus of the sigmoid colon, was not present, volvulus was not considered. The absence of feces in the rectum and the findings on barium enema examination ruled out fecal impaction. External hernias were absent and although intra-abdominal adhesions could not be ruled out as the cause of the obstruction, the tapering air column on the x-ray film made the diagnosis unlikely.

Peritoneal spread of carcinoma from other abdominal organs to the intestinal tract is common. Complete obstruction of the colon from this source is unusual, but small intestinal obstruction is frequently seen. In this instance carcinoma of the bladder appeared to be confined to the bladder wall and under good control.

Was Immediate Surgical Intervention Necessary?

In obstruction of the colon, the loss of fluids and electrolytes rarely imposes a serious problem. This is because reabsorption of fluids secreted in the upper gastrointestinal tract and storage of feces are the main functions of this part of the intestinal tract. More important is the degree of distention proximal to the obstruction and the presence or absence of a competent ileocecal valve. The colon can tolerate

great increases in the caliber of its lumen, but in time the intraluminal pressure will increase so that the tension exerted upon the wall will be sufficient to cause stasis of venous outflow, trapping blood within the bowel wall. As the intraluminal pressure further increases, the tension exerted on the bowel wall equals the arterial pressure, producing arterial stasis with resultant gangrene.

If the ileocecal valve is competent, a closed loop obstruction is present. Thus fluid and air from the small intestine may enter the dilated proximal colon but are prevented from returning to the small intestine. This creates an obstruction both proximally by the ileocecal valve and distally by the obstructing lesion. Accompanying this is the ever increasing accumulation of fluid and air within the closed loop. This is caused by the continued passage of small intestinal contents from the ileum into the right colon and the progressive decrease in the colonic wall's ability to absorb fluid. The absence of air in the small intestine in this patient indicated competency of the ileocecal valve with the potentially serious closed loop problem. The usual site of perforation in closed loop obstruction of the colon is the cecum, since its lumen has the largest diameter and therefore develops the greatest stress upon its walls.

The degree of distention of the colon on admission was such that emergency colostomy to relieve the possible closed loop obstruction was not considered necessary at that time.

PREOPERATIVE PREPARATION

Preoperative preparation consisted of replacing fluid and electrolytes lost prior to admission, giving transfusions to replace the blood volume deficit, administering intestinal and systemic antibiotics, and making a close scrutiny of the obstructed colon for changes in the caliber of its lumen and impairment of the blood supply.

From the history of vomiting, a moderate degree of dehydration was expected. In addition, fluid had been lost in the lumen of the distended colon through decreased reabsorption. The essentially normal skin turgor, blood urea nitrogen and serum electrolytes suggested that dehydration was not too severe. Kidney function was considered good since, on admission, urinalysis demonstrated adequate ability to concentrate (specific gravity of 1.025) and the blood urea nitrogen (10 mg. per cent) indicated very little pre-renal deviation of fluids. The patient was hydrated with 5 per cent dextrose in water and 5 per cent dextrose in normal saline. After adequate urinary excretory function was demonstrated, potassium chloride was added.

The recent 20-pound weight loss indicated a probable 1,000 cc. blood volume deficit. In addition, there was a pooling of blood in the distended loops of colon, further decreasing the circulating blood volume. In the first two days 500 cc. of blood were given daily. A hemoglobin of 14.2 gm. per cent was reported on the third day.

Neomycin, 1.0 gm., was given orally four times daily to decrease the bacterial content of the colon. The aim was to prepare for surgery on the colon as well as to treat the diverticulitis. Neomycin given orally, through its sterilizing ability, is also believed to have a beneficial effect on the survival time of bowel with a compromised vascular supply. Tetracycline, 100 mg. intramuscularly four times daily, was administered since abscess formation was also considered present. Neomycin given locally in the bowel was considered inadequate treatment of an abscess.

The patient was given nothing by mouth except neomycin and 60 cc. of mineral oil daily. A nasogastric tube was not used, since gastric suction would have no effect on the distention already present in the colon. If the obstruction were so complete that neomycin, mineral oil, tetracycline and absence of oral intake would not improve the degree of obstruction, colostomy would have to be done. The edema of the bowel wall and adjacent mesentery at the site of diverticulitis was expected to subside enough to allow air and fluid to pass by the obstructed segment of colon.

HOSPITAL PROGRESS

During the first forty-eight hours after admission vomiting did not occur. On two occasions a small amount of flatus was expelled rectally. However, on the evening of the second day the abdomen was more distended and abdominal tenderness had increased. The white blood count was 11,100 per cu. mm. with a total neutrophil count of 78 per cent. Flat and upright films of the abdomen demonstrated a 50 per cent increase in the caliber of the dilated colon. Absence of air was again noted in the sigmoid colon and rectum. The obstructed

colon was considered to be deteriorating, with the possibility of imminent gangrene of the cecum. A nasogastric tube was inserted and connected to suction so as to empty the stomach of any saliva or gastric secretions prior to surgery.

SURGERY

Through a transverse incision in the right upper quadrant the peritoneal cavity was entered and clear, amber fluid was found. A right transverse loop colostomy, using two glass rods placed through the mesentery, was performed. With the use of two rods placed several centimeters apart, complete fecal deviation will be obtained. This allows rapid regression of the inflammatory process by eliminating the peristaltic activity of the diseased bowel. Considerable fluid and air were aspirated from the distended colon by means of an 18 gauge needle placed into the loop of colon to be exteriorized. The intraluminal pressure was thus decreased and the tension on the cecal wall diminished. The mesentery of the transverse colon was sutured to the caudal side of the peritoneum of the abdominal wall to prevent herniation of small intestine between it and the abdominal wall structures.

POSTOPERATIVE COURSE

Postoperatively the patient remained on gastric suction for thirty-six hours. During this time the exposed colon was repeatedly aspirated to decrease the intraluminal pressure of the exposed loop as well as the obstructed colon. On the second postoperative day the loop colostomy was opened longitudinally with cautery, the nasogastric tube was removed, and the patient was placed on a liquid diet. Currently, a more acceptable manner of handling the colostomy is to open it at the completion of surgery as this assures an adequate decompression of the closed loop. Leakage of fecal material into the colostomy incision is not a problem. If the repeated aspiration method is employed, the right colon may be inadequately decompressed and the closed loop obstruction not corrected. Daily warm saline irrigations through the distal colostomy opening were begun on the fourth postoperative day to remove all fecal material present within the non-functioning lower colon. Barium enema examination through the distal loop of the colostomy on the sixth postoperative day demonstrated a tapered irregularity of the distal descending colon. It also showed narrowing of the remainder of the sigmoid to the rectosigmoid junction with an initial delay of passage of barium but with complete evacuation later. The conclusion was diverticulitis of the sigmoid colon. Daily irrigations through the proximal colostomy opening were started on the seventh day. The glass rods were removed one at a time on the seventh and ninth days with no subsequent retraction of the colostomy loop.

With the roentgenographic findings and the decreasing degree of obstruction, the diagnosis of diverticulitis rather than carcinoma was established. The patient was discharged with the recommendation that the descending and sigmoid colon be excised after a three-month period which would permit the inflammatory process to subside. Mortality and morbidity from resection of the colon have been shown to be less if the inflammatory process is given time to subside.

SECOND HOSPITAL ADMISSION

Interval History and Preoperative Preparation

Between hospital admissions the patient ate normally and without abdominal symptoms. A high protein, low calorie diet was followed because of his obesity. No feces had passed rectally, thus indicating the completeness of fecal deviation with the colostomy using two glass rods. Daily irrigations of the proximal colostomy opening were carried out with normal function observed.

The admitting urinalysis was normal; red blood count, 5.19 million per cu. mm.; hemoglobin, 13.8 gm. per cent; white blood count, 8,400 per cu. mm. and a normal differential; total protein, 7.5 gm. per cent with 4.1 gm. per cent albumin and 3.4 gm. per cent globulin. Barium enema examination through the distal colostomy opening demonstrated no evidence of active diverticulitis or obstruction. The bacterial content of the left colon and rectum was reduced by irrigations of saline containing neomycin. Blood was cross matched and a nasogastric tube was inserted and connected to suction prior to surgery. A repeat barium enema examination prior to resection was helpful in evaluating the present status of the diverticulitis and to further rule out the presence of carcinoma in the involved segment. During surgery the anatomical relationships

and the etiology of the process are obscured at times by residuals of the inflammatory process.

Surgery

Through a left hockey stick incision, the lower half of the descending and the entire sigmoid colon to the promontory of the sacrum were found involved in a large inflammatory mass extending well out into the mesentery. No evidence of fistula formation or frank perforation was found. After freeing the splenic flexure, the entire left colon was dissected free. Care was exercised to avoid injury to the left ureter and spermatic vessels. The left colon from the splenic flexure to the superior rectum was resected and end-to-end closed one-layer anastomosis was made. Multiple areas of diverticulitis with focal chronic inflammation in the bowel wall were found on pathological examination.

Postoperative Course

Following surgery, gastric suction was maintained for the first two postoperative days and an accurate intake and output was recorded. Procaine penicillin, 400,000 units, and streptomycin, 0.5 gm. every twelve hours, were administered prophylactically against pulmonary and abdominal sepsis. On the fifth postoperative day irrigations of saline through the distal colostomy opening demonstrated prompt passage through the anastomosis, thus assuring its patency. The patient was discharged with instructions to return in two weeks for closure of the colostomy.

Experience has shown that resection of a colon involved with diverticulitis, while it leaves the colon with residual diverticulosis, rarely leads to inflammatory changes in the abnormal bowel. Complete removal of the colon with diverticular changes would have necessitated total colectomy with ileoproctotomy. The magnitude of the surgery and the subsequent probabilities of multiple watery stools following operation made the latter choice undesirable in this elderly male.

THIRD HOSPITAL ADMISSION

Interval History and Preoperative Preparation

The convalescence in the interim was entirely normal. The patient was completely ambulatory and was eating without complaints. Two days prior to his return to the hospital the patient was given neomycin orally, 1.0 gm. four times daily, to decrease the bacterial content of the proximal colon. On the morning of surgery a nasogastric tube was inserted and connected to suction. The colon proximal to the colostomy was irrigated through the proximal loop to remove all fecal material.

Surgery

The colostomy was dissected free of the abdominal wall, closed in two layers transversely in order not to compromise the lumen, and returned to the peritoneal cavity. The abdominal wall fascia was closed with No. 2-0 silk and a Penrose drain placed in the subcutaneous tissues. The drain, removed twenty-four hours following surgery, acted as a wick to allow evacuation of serum from the potentially contaminated subcutaneous area. Thus it removed an excellent culture medium for the growth of bacteria. The nasogastric tube was removed on the second postoperative day, and a progressive clear liquid to regular diet was begun. Prior to removal of the nasogastric tube, good peristalsis was noted and flatus was expelled rectally on more than one occasion. The absence of ileus and the patency of the lumen at the site of colostomy closure were thus demonstrated. Convalescence was uneventful.

When last seen three years later the patient was having two formed bowel movements daily with no recurrence of any gastrointestinal symptoms suggestive of diverticulitis.

The Diagnostic Corner

An injury to the wrist which frequently results in much functional disability because of delayed treatment due to a lack of early radiologic diagnosis.

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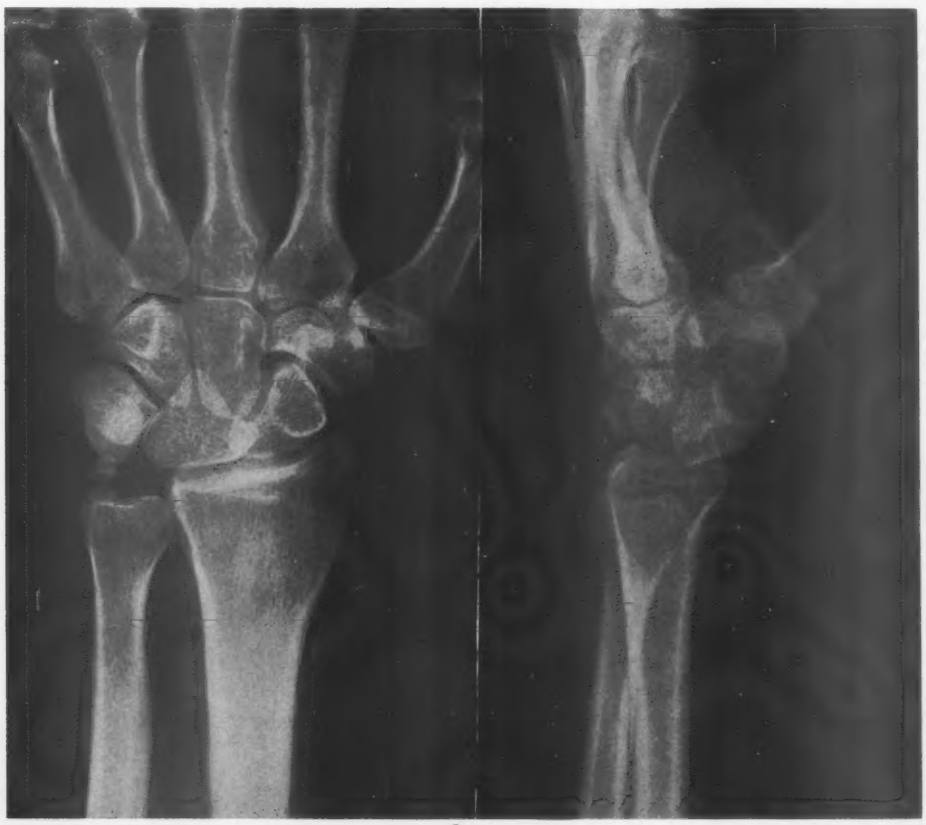
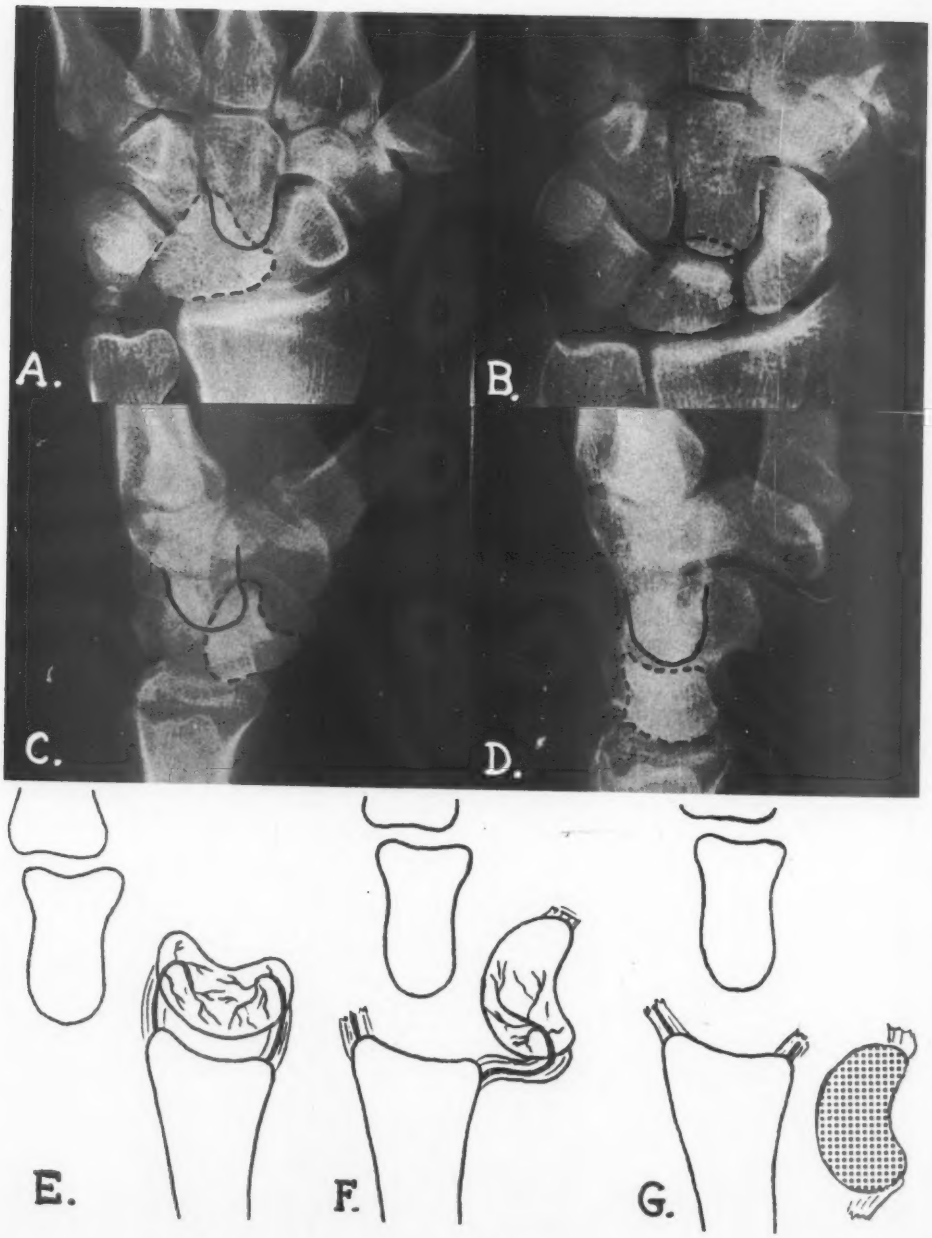


THIS thirty-two-year old white man fell 15 feet and sustained a mild cerebral concussion, a fracture of the right superior pubic ramus and a dislocated left elbow. There was also pain and limitation of flexion in the left wrist, and the x-rays (opposite) were therefore obtained. They clearly show a serious traumatic lesion which should be treated without delay in order to avoid serious disability. *What is your diagnosis?*

Please turn page for answer

Diagnosis

Forward (palmar) dislocation of the carpal lunate bone.



In the films shown opposite there are seen the typical x-ray findings of this lesion which is almost always produced by a fall on the outstretched hand. In the frontal projection (A) the dislocated lunate (dotted lines) is pie-shaped in appearance in contrast to the normal quadrilateral appearance (B). Furthermore, when the lunate is dislocated its distal portion overlaps the proximal portions of the capitate and hamate, in contrast to the normal appearance in which the cartilage spaces between the lunate and surrounding carpal bones are clearly visible. In the lateral projection (C) the dislocated lunate (dotted lines) can be seen with its cup which normally articulates with the head of the capitate (solid black lines) directed toward the palmar aspect of the wrist. The normal relationship of the lunate in lateral position is shown in (D).

There are three different types of dislocation involving the lunate. In one type (E) the lunate itself remains in normal position, the head of the capitate being dislocated backward (dorsally) out of the cup of the lunate. The blood supply of the lunate remains intact in this so-called "perilunar" dislocation. The case presented herein is the most common type (F) in which the lunate is dislocated forward toward the palmar aspect of the wrist. In this type the dorsal ligaments are torn, thus eliminating that portion of the blood supply carried through that ligament, although the intact anterior ligament still carries blood to the lunate. If this type is reduced early, a perfect result with complete freedom from arthritis may be expected. If diagnosis and reduction are delayed the dislocated lunate in its new bed becomes surrounded by fibrous tissue which makes later operative reduction difficult. Furthermore, because of the difficult dissection the surviving blood vessels in the anterior ligament may be destroyed, with the resultant aseptic necrosis preventing a good result in spite of good anatomic reduction. In the third type (G) there is total dislocation of the lunate with complete rupture of both dorsal and palmar ligaments. Avascular necrosis is then inevitable and early excision of the dislocated lunate is therefore the treatment of choice.

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Our Surgical Heritage

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UNITED STATES OF AMERICA

EPHRAIM MCDOWELL

EPHRAIM McDOWELL was born on November 11, 1771, in Rockbridge County, Virginia. His father, Judge Samuel McDowell, was a member of the legislature of Virginia until appointed a judge and land commissioner for Kentucky. In 1783 the family moved to Kentucky where young Ephraim attended the seminary of Worley and James at Georgetown, Kentucky.

In 1790 Ephraim began the study of medicine with Dr. Humphreys of Staunton, Virginia, and in 1793 he started his formal education at the age of twenty-two. He became a student at the University of Edinburgh where he came under the influence of Alexander Munro, the anatomist, and John Bell, the Surgeon. It was then taught that to open the abdominal cavity was fatal and therefore no one was so bold as to undertake such an operation. No surgeon recognized the relationship between infection and surgery

in the abdominal cavity and it took seventy-four years before Lister's work on antisepsis made such operations frequent.

McDowell returned to the United States after two years of study in Edinburgh and started a practice in Danville, Kentucky. He developed a large practice and became the leading surgeon in that part of the country. In 1802 Ephraim McDowell married Sarah Shelby, the daughter of the first governor of Kentucky, General Isaac Shelby. In 1807 Dr. McDowell was given the diploma of the Medical Society of Philadelphia. Two years later he performed the first successful ovariotomy in history on Jane Todd Crawford and thus became the father of abdominal surgery. In 1812 he operated on James K. Polk for a urinary calculus; Polk later became the eleventh president of the United States. In 1825, at the age of fifty-four, Dr. McDowell was awarded the degree of Doctor of Medicine by the University of Maryland. He was one of the founders and a member of the first board of trustees of Centre College of Danville, Kentucky.

His greatest contribution to surgery was performing the first successful ovariotomy in the world. His publication entitled "Three Cases of Extirpation of Diseased Ovaria" was published in the *Eclectic Repertory and Analytical Review, Medical and Philosophical*, in 1817. Dr. McDowell died on June 20, 1830, at the age of sixty-nine after a short illness, and the supposition has been that he died as a result of acute suppurative appendicitis.

EUROPE

JOHN BELL

JOHN BELL was born on May 12, 1763, in Edinburgh, the son of Reverend William Bell. He received his early education at the high school of Edinburgh and became a pupil of Alexander Wood, then a well known Edinburgh surgeon. He became a Fellow of the Royal College of Surgeons of Edinburgh, and in 1780 was made lecturer on anatomy and surgery in the University. For twenty years John Bell was a leading surgeon in Edinburgh and a teacher in the University. It was during this period that he published his revolutionary work on the "Nature of Wounds," in which he gave a clear exposition of the advantages of securing first intention in healing rather than keeping the wound open for an interminable time, as was formerly practiced.

His early work in vascular surgery certainly deserves to make him one of the founders of modern surgery. He tied the carotid and also the posterior branch of the internal iliac successfully, and was the first to publish a report of ligation of the gluteal artery.

Probably John Bell's most enduring contributions to surgery were his "Discourses on the Nature and Cure of Wounds" published in 1795 and his monumental "Principles of Surgery" published in 1801 and also in 1807. He was one of the most skillful operating surgeons of his time and the teacher of the immortal Ephraim McDowell.

John Bell took the labors of his profession with great seriousness which often led him into bitter controversy. He died in Italy in 1820.